A Previous Birth Technique (PBT) manual

BASICS

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PBT

A Previous Birth Technique Manual

Part I: For Health Workers

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INTRODUCTION

This PBT manual is divided into two parts. Part I is for health workers who are routinely involved in contact with mothers and in collecting information from them. Part II is for managers, supervisors, and officials who design and oversee the collection of health data and analyze the results.

Part I gives you, the health worker, directions for a simple method of collecting information about child survival and child deaths. The method (called the Previous Birth Technique, or PBT) is an easy way to obtain up-to-date information on trends in mortality for children of mothers visiting health facilities. Such information/can help you keep track of the progress your health facility is making to improve child survival.

EXAMPLE

A simple example will illustrate how the PBT works. Suppose during one year in a certain hospital, 1,100 women gave birth; 100 of these births were to women giving birth for the first time and 1,000 were to women having their second or later birth. When the 1,000 women who had prior births were asked about the survival of their most recent birth, 750 said that their previous child was still a/live and 250 said the child had already died. Thus, of the 1,000 previous births, one out of every four had died. We can say that the chances of dying by the time of the next birth were high: one out of four, or 25 percent. The chances of survival were three out of four, or 75 percent.

Suppose during the next year there were again 1,100 women in the same hospital who gave birth, and again 100 of these were to women giving birth for the first time and 1,000 were to women having their second or later birth. When the 1,000 women were asked about the survival of their most recent birth, 800 said.the their previous child was still alive and 200 said the child had already died. Thus, of the 1,000 previous births, one out of every five had died, We can say that the chances of dying by the time of the next birth were not quite so high: one out of five, or 20 percent. The chances of survival were four out of five, or 80 percent.

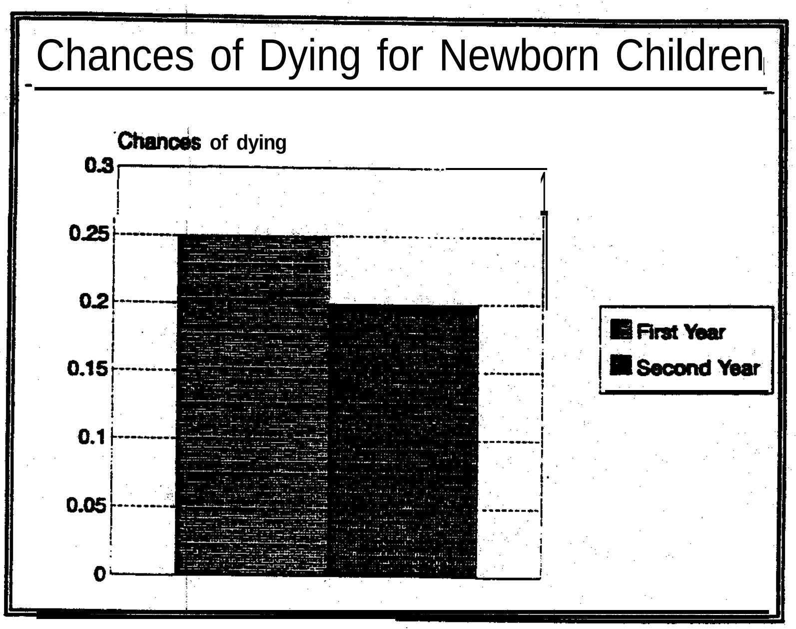
From these observations it seems that childhood mortality has recently fallen, because lower proportions of children were dying by the time their mothers had given birth again.

The graph below illustrates these results. It is clear that the chances of dying for newborn children declined from the first year to the next.[1]

That's basically all there is to the method. If information is collected from new mothers[2] on the survival of their previous birth, we can draw conclusions about the trends of child survival and child mortality, usually in the form of what is called an "Index of Early Childhood Mortality" or IECM.

$$\text{IECM} = \frac{\text{Deaths to previous births}}{\text{All previous births}}$$

The IECM can be calculated easily and quickly, so any recent trends in childhood survival will be apparent.' The information produced in.this way is useful in many ways. For example, high risk mothers can be identified for followup action.



In this manual you will find directions for applying the PBT when a woman comes to health facility at any one of three times: 1) to give birth (as illustrated in the example above); 2) for antenatal care when pregnant; and 3) after a recent birth to have her new child vaccinated. In the manual you will find what questions you need to ask the women-, when the questions should be asked, and what happen6 to the data you Collect.' To make it easy to find what to do in your_ particular situation, we have divided the discussion into three parts. In each we have detailed the steps you need to take for the situation you are in (at birth, antenatal visit, vaccination visit).

For each of the three different situations, there are different ways in which the PBT questions can be'worded and different ways in which the questionnaires can be designed. In this short manual we do not try to include all possible variations. Rather, we seek to present the basic ways in which the PBT can be applied and used. You and your supervisors and co-worker6 can take what you find below and adapt it to your own particular circumstances.

It is important to understand that you will not be asking the PBT questions by themselves; they are additions to what you have already been doing, and they will be asked at the same time as other question6 you have already been'asking. If information from some questions included on the sample questionnaires below (for example, the question on previous pregnancies') is already being collected, then the PBT form need not include these questions again and may be shortened.

Eventually, the PBT questions will be integrated into the forms you use and will not be separate. They are shown separately below because there are many different systems and questionnaires for collecting information in use and it is impossible to include all of these in this manual.

SUMMARY

- The Previous Birth Technique involves asking women questions about the survival of their previous birth. The technique can be applied in three different situations:

  - when a mother comes to a health facility to give birth
  - when a pregnant woman comes to an antenatal clinic
  - when a mother brings a new child to a health facility for vaccination.

- Answers to the PBT questions can be used to calculate an Index of Early Childhood Mortality (IECM):

$$\boxed{\text{IECM} = \frac{\text{Deaths to previous births}}{\text{All previous births}}}$$

The IECM can be used to measure trends and levels of childhood mortality at your health facility.

THE PBT AT BIRTH

In this section we discuss applying the PBT when a woman comes to give birth in a health facility. When she is registered, you already routinely ask her some questions about herself, including such things as age, number of previous children, etc., or whatever is on the form you use. Applying the PBT at birth simply involves asking mothers a few more brief questions at the same time.

ASKING THE QUESTIONS

You can obtain the basic PBT information from a few short questions. If you have been collecting.information on mothers using separate forms for each woman, during the initial period of using the PBT you will probably use an additional sheet of paper with the PBT questions on it for each woman. If you have been collecting information on mothers by using a register book, you will probably use a separate register sheet with the PBT questions on it. Later the questions will be included on the basic form which you use to collect all information about the mothers.

The At-Birth.PBT Forms

Shown on the next pages are sample forms for collecting at-birth PBT data in two common ways: with separate forms or by using register sheets. Whichever approach you use, the forms must be filled out for all mothers who come to deliver in your health facility.[6]

==

PREVIOUS BIRTH TECHNIQUE RECORD FORM AT TIME OF BIRTH

[NAME OF HEALTH FACILITY]

==

DATE (Day/Month/Year) / /

NAME OF *MOTHER* ______________________________

IDENTIFICATION NUMBER OF MOTHER ____________________

==

1. I would like to record some information about your pregnancies. Have you had any previous pregnancies?

___ No [End of PBT questions1

___ Yes [Go to Question Number 2]

2. Was the outcome of your last pregnancy a live birth, a stillbirth, *or* a miscarriage? *(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)*

___ Livebirth [Go to Question 41

_ Stillbirth or miscarriage [Go to Question 31

3. Before this birth, did you ever have a live birth? *(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)*

___ No [End of PBT questions]

Yes [Go to Question Number 41

4. Is your most recently-born child still living? *(If the previous live birth was actually twins, ask the question and fill in the answers for both of the twins.1*

___ **Yes** Second child (if twins) : ___ Yes

___ No ___ **No**

==

Signature of recorder: ____________________

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PRECEDING BIRTH TECHNIQUE REGISTER SHEET AT TIME OF BIRTH

[NAME OF HEALTH FACILITY]

(For Questions number 2 and 3, make** sure the woman* understands that "live*** birth" does *not include* stillbirths or miscarriages. Only a *child who ever cried 'or* breathed, *even* if he *or she lived only* a short *time,* should be ***included** for* **PBT.)**

(Do *not ask* Questions *number 4 and 5 if the* answer to Question *number* ***3*** *is NO.)*

			1. Have you had any previous pregnancies?		*2.* **Was the** outcome of your last pregnancy a live birth, a stillbirth, or a miscarriage?		3. Before this birth, did you ever have a live birth?		4. Is your most recently born child still living?		5. (In ***case*** *of twins*) Is the **second** twin still living?	
DATE	MOTHER'S NAME	MOTHER'S **IDENTI-** FICATION NUMBER	YES **(=>2)**	**NO (STOP)**	LIVE BIRTH **(=>4)**	STILLBIRTH OR MISCARRIAGE **(=>3)**	YES **(=>4)**	**NO (STOP)**	YES	NO	YES	NO

Be sure to write in the date and the mother's name and identification number (if available). Next ask the PBT questions and record the answers. Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included in the PBT questions'. Make sure to include ***all*** live births, including children who died very early, for example between birth and the naming ceremony. If the most recent live birth was twins, provide the information for each one.

The wording of the questions may vary; the actual questions you will use and the way they are included on **your form** will be decided by your supervisors and the Ministry of Health. (If it has been decided that additional questions, such as sex of previous child, will be added along with the PBT questions, the forms you fill in will include those questions-)

TIMING

The best time to ask the PBT questions is when you are gathering other information.* If, as is commonly the case, *you* usually ask a woman **a series** of questions when she registers ***before*** she gives birth, that is the time to ask the PBT questions. If, on the other hand, you routinely collect information ***after*** the birth, that is the time to ask the PBT questions. (In this case, you should ask the PBT questions ***regardless*** of whether the woman has just had a live birth, a **stillbirth, or** a miscarriage. ***Any woman*** who comes to deliver in your facility should be asked these questions.)

BE CAREFUL!

The PBT questions are not complicated, but it is still possible to make mistakes, so you must be careful. Please make sure that you get information on the woman's previous *live* birth. If her previous pregnancy ended in a stillbirth or miscarriage, *information about that pregnancy should not be included.* (Of course, you may collect information on stillbirths and miscarriages elsewhere for other purposes.) Inquire further to find out if she has had a previous delivery that resulted in a live birth, even if the child lived only a short time. If there was no previous live birth, answer NO to Question Number 3 and stop.

WHAT HAPPENS NEXT

Periodically (for example, every three months?) the information on the survival of previous births which you and your co-workers have collected will be used to calculate an Index of Early Childhood Mortality (IECM). The IECM is simply the ratio of the number of previous births which had died to the total number of previous births:

$$\text{IECM} = \frac{\text{Deaths to previous births}}{\text{All previous births}}$$

This at-birth IECM can be compared to at-birth IECMs for previous periods to give an indication of whether child mortality in your area- has been falling, constant, or even-rising. This in turn will provide information to help plan better services and to identify families at high risk.[4,10]

SUMMARY

- The Previous Birth Technique can be applied when women come to a health facility to give birth.
- Care must be taken so that only live births are included. Previous pregnancies that ended in a stillbirth or miscarriage should not be included.
- Answers to the PBT questions administered at time of birth can be used to calculate an Index of Early Childhood Mortality (IECM). This at-birth IECM can be used to measure trends and levels of childhood mortality at your health facility.

THE ANTENATAL PBT

In this section we discuss applying the PBT when a woman comes to a health facility for an antenatal examination. Applying the PBT in an antenatal setting simply involves asking the woman a few more brief questions at the same time that you obtain other routine information about her pregnancy.

ASKING THE 'QUESTIONS

YOU can obtain the basic PBT information from a few short questions. If you have been collecting information from pregnant women using separate forms for each woman, during the initial period of using the PBT you will probably use an additional sheet of paper with the PBT questions on it for each woman. If you have been collecting information from pregnant women by using a register book, you will probably use a separate register sheet with the PBT questions on it. Later the questions will be included on the basic form which you use'to collect all information about the women.

The Antenatal PBT Forms

Shown on the next pages are sample forms for collecting antenatal PBT data in two common ways: with separate forms or by using register sheets. Whichever approach you use, the forms must be filled out for every pregnant woman who comes to your health facility for her first antenatal visit. You should collect information only once from each woman. Make sure that the woman has not been asked the PBT questions on an earlier visit during the current pregnancy. ***Do not fill in the form for second or later visits.***

Be sure to write'in the date and the mother's name and identification number (if available). Next ask the PBT questions and record the answers. Make sure that the woman understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included. Make sure to include ***all*** live births, including children who died very early, for example between birth and the naming ceremony. If the most recent live birth was twins, provide the information for each one.

The wording of the questions may vary; the actual questions **you** will use and the way they are included on a form will be decided by your supervisors and the Ministry of Health. (If it has been decided that **additional** questions, such **as' sex** of previous child, will be added along with the PBT questions, the forms you fill in will include those questions.)

TIMING

The best time to ask the PBT questions is when you are gathering other information on the pregnancy. -Eventually the questions will be included on the standard questionnaire which you use.

BE **CAREFUL!**

The PBT questions are not complicated, but it is still possible to make mistakes, so you must be careful. Please make

PREVIOUS BIRTH TECHNIQUE RECORD FORM AT ANTENATAL VISIT

[NAME OF HEALTH FACILITY]

DATE (Day/Month/Year) / /

NAME OF MOTHER ______________________________

IDENTIFICATION NUMBER OF MOTHER ______________________________

1. Have you been asked questions about previous births on an earlier visit to this facility during this pregnancy?

___ Yes [End of PBT questions; set aside and verify to avoid double-counting]

___ No [Go to Question Number 2.]

2. I would like to record some information about your pregnancies. Have you had any previous pregnancies?

___ No [End of PBT questions]

___ Yes [Go to Question Number 3]

3. Was the outcome of your last pregnancy a live birth, a stillbirth, or a miscarriage? (Make *sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only* a *child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)*

___ Livebirth [Go to Question 5]

___ stillbirth or miscarriage [Go to Question 4]

4. Have you ever had a live birth? *(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed,* even *if he* or *she lived only* a *short time, should be included for* PBT.)

No [End of PBT questions]

Yes [Go to Question Number 5]

5. Is. your most recently-born child still living? *(If the previous live birth was actually twins, ask the question and fill in the answers for both of the twins.)*

Yes Second child (if twins): Yes

___ No No

Signature of recorder: ______________________________

PRECEDING BIRTH TECHNIQUE REGISTER SHEET AT ANTENATAL VISIT

[NAME OF HEALTH FACILITY]

'(Interviewer: Make *sure'* *the* woman has not already *been* asked *these* questions *on a previous* visit *during the current pregnancy.)*

(For Questions *number 2* and 3, *make* sure the woman understands that "live birth" *does not include stillbirths or miscarriages. Only* a child *who ever cried or breathed, even if he or she lived only* a short time, should be *included for PBT.)*

(Do not ask Questions *number 4 and* **5** *if the answer to Question number 3 is NO.)*

			1. Have you had any previous **pregnancies?**		*2.* **Was** the outcome of your **last** pregnancy a live birth, a stillbirth, or a miscarriage?		*3.* Have you *ever* had a live birth?		4. Ie your **most** recently born child still living?		5. *(In case of twins)* 15 the second twin **still** living?	
DATE	MOTHER'S NAME	MOTHER'S **IDENTI-** FICATION NUMBER	YES **(=>2)**	**NO (STOP)**	LIVE BIRTH **(=>4)**	STILLBIRTH OR MISCARRIAGE **(=>3)**	YES **(=>4)**	**NO (STOP)**	YES	NO	YES	NO

sure that you get information on the woman's most recent live birth. If her previous pregnancy ended in a stillbirth or miscarriage, *information about that pregnancy should not be included.'* Inquire further to find out if she has had a previous delivery that resulted in a live birth, even if the child lived only a short time. If there was no previous live birth, answer NO and stop. If there was no previous pregnancy, answer NO and stop.

You should be collecting information only once from each woman. Make sure that the woman has not been asked the PBT questions on an earlier visit during the current pregnancy. *Do not fill in the form for second or later* visits.

WHAT HAPPENS NEXT

Periodically (for example, every three months[9]) the information on the survival of previous births which you and your co-workers have collected will be used to calculate an Index of Early Childhood Mortality (IECM). The IECM is simply the ratio of the number of previous births which had died to the total number of previous births:

$$\boxed{\text{IECM} = \frac{\text{Deaths to previous births}}{\text{All previous births}}}$$

This antenatal IECM can be compared to antenatal IECMs for previous periods to give an indication of whether child mortality in your area has been falling, constant, or even rising. This in turn will provide information to help plan better services and to identify families at high risk.[4,10]

SUMMARY

- The Previous Birth Technique can be applied when pregnant women come to a health facility for antenatal care.
- Care must be taken so that only live births are included. Previous pregnancies that ended in a stillbirth or miscarriage should not be included.
- Care should be taken to avoid double-counting of women who come for more than one antenatal visit.
- Answers to the PBT questions in an antenatal situation can be used to calculate an Index of Early Childhood Mortality (IECM). This antenatal IECM can be used to measure trends and levels of childhood mortality at your health facility.

THE PBT AT TIME OF VACCINATION

In this section we discuss applying the PBT when a woman 'comes to a health facility to have her most recently-born child vaccinated. You have already been asking such mothers some questions about themselves, including such things as age, number of previous children, etc., or whatever is on the form you use: Applying the PBT in a post-natal setting simply involves asking the mother a few more brief questions at the same time.

ASKING THE QUESTIONS

You can obtain the basic PBT information from a few short questions. If you have been collecting information on mothers and their new children using separate forms, during the initial period of using the PBT you will probably use an additional sheet of paper with the PBT questions on it, If you have been collecting information by using a register book, you will -probably use a separate register sheet with the PBT questions on it. Later the questions will be included on the basic form which you use to collect all information about the mothers and children.

The Vaccination PBT Forms

Shown on the next pages are sample forms for collecting vaccination PBT data in two common ways: with separate forms or by using register sheets. Whichever approach you use, the forms must be filled out for every mother who brings her most recently-born child to your health facility for the first time to be vaccinated.

You should be collecting information only once from each woman. Make sure that the woman has not been asked the PBT questions on an earlier visit to have her newest child vaccinated. ***Do not fill in the form*** for second or later visits.

Be sure to write in the date and the mother's name, the most recently-born child's name and identification number (if available"). If the child being vaccinated is more than nine months old, ask if any children have been born after it. This question is included to make sure the child being vaccinated is the woman's most recent child; if another child has more recently been born to the woman, do not ask the PBT questions.

Next ask the PBT questions about the child preceding the most recently-born child and record the answers. Make sure the mother understands that "live birth" does not include stillbirths or miscarriages.' Only a child who ever cried or breathed, even if he or she lived only a short time, should be included. Make sure to include ***all*** live births, including children who died very early, for example between birth and the naming ceremony. If the **birth preceding** the most recent live birth was twins, provide the information for each one.

The wording of the questions may vary; the actual questions you will use and the way they are included on a form will be decided by your supervisors and the Ministry of Health. (If it has been decided that additional questions, such as sex of previous child, will be added along with the PBT questions, the forms you fill in will include those questions.)

TIMING,

The best time to 'ask the PBT questions is when you are gathering other information about the mother and the child being vaccinated. Eventually the questions will be included on the standard questionnaire which you use.

PREVIOUS BIRTH TECHNIQUE RECORD FORM AT TIME OF VACCINATION VISIT
[NAME OF HEALTH FACILITY]

DATE (Day/month/Year) ___/___/___

NAME OF MOTHER ______________________________

NAME OF CHILD BEING VACCINATED ______________________________

IDENTIFICATION NUMBER OF CHILD BEING VACCINATED ____________

1. Have you been asked questions about previous children on an earlier visit to this facility to have this child vaccinated?

___ Yes [End of PBT questions; set aside and verify to avoid double-counting]

___ No [Go to Question No. 2.1

2. [ASK THIS QUESTION ONLY IF CHILD BEING VACCINATED IS ***MORE THAN 9*** MONTHS OLD.1 Since the birth of [name of child], have *you* given birth to another child, that is, another child who was born alive? ***(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)***

___ Yes [End of PBT questions]

No ___ [Go to Question Number 3]

3. I would like to record some information about your pregnancies. Have you had any previous pregnancies?

___ No [End of PBT questions]

___ Yes [Go to Question Number 41

4. Was the outcome of your last pregnancy a live birth, a stillbirth, or a miscarriage? ***(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)***

___ Livebirth [Go to Question 6]

___ Stillbirth or miscarriage [Go to Question 51

5. Before this birth, did you ever have a live birth? ***(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)***

___ ***No*** [End of PBT questions]

___ Yes [Go to Question Number 6]

6. Is the child born most recently before this one still living? ***(If the previous live birth was actually twins, ask the question and fill in the answers for both of the twins.)***

___ ***Yes*** Second child (if twins): ___ ***Yes***

___ No ___ No

Signature of recorder: ______________________________

PRECEDING BIRTH TECHNIQUE REGISTER SHEET AT TIHE VACCINATION VISIT

[NAME **OF** HEALTH FACILITY]

(Interviewer: *Make* **sure** *the woman has not already* **been** *asked these* **questions** *on* a *previous* **visit** *to have this* **child** vaccinated.)

(For Questions 1, 2, and 3, make sure the woman understands that **"live birth"** does not *include* stillbirths or miscarriages. Only a child *vho ever cried or* **breathed**, *even if he or she lived only a short time, should be' included for PET.)*

(Do **not** ask **Questions** number *5 and 6 if* **the answer** *to* **Question** *number 3* **is** *NO.)*

DATE	MOTHER'S NAME	MOTHER'S **IDENTI-FICATION NUMBER**	1. *[Ask thfs* **question** only if **child being** *vaccinated* **is** *more* **than 9 months** *old.]* Since the birth *of* **[name** *of* child], have you given birth to another child, that is, another child **born** alive? YES (STOP)	**NO (=>2)**	2. **Did you** ever have any pregnancies before the one leading to this child's birth? YES **(=>3)**	**NO (STOP)**	**3.** Was the outcome of your **previous** pregnancy a live birth, a **stillbirth,** or a **miscarriage?** LIVE BIRTH **(=>5)**	STILLBIRTH OR MISCARRIAGE **(=>4)**	**4.** Did you ever have a live birth **before** this one? YES **(=>5)**	**NO (STOP)**	5. **Is** your moat recently born child **still** living? YES	**NO**	**6.** (In case *of* **twins) Is** the second twin **still** living? **YES**	no

BE CAREFUL!

The PBT questions are not-complicated, but it is still possible to make mistakes, so you must be careful. ***If the mother had had another child since giving birth to the child being vaccinated, stop.***

Please make sure that you get information on the woman's most recent ***live*** birth ***preceding the child being vaccinated.*** If the previous pregnancy ended in a stillbirth or miscarriage, ***information about that*** pregnancy ***should not be included.***[7] Inquire further to find out if she had a previous delivery that resulted in a live birth, even if the child lived only a short time. If there was no previous live birth, answer NO and stop.

WHAT HAPPENS NEXT

Periodically (for example, every three months[9]) the information on the survival of previous births which you and your co-workers have collected will be used to calculate an Index of Early Childhood Mortality (IECM). The IECM is simply the ratio of the number of previous births which had died to the total number of previous births:

$$\boxed{\text{IECM} = \frac{\text{Deaths to previous births}}{\text{All previous births}}}$$

This vaccination IECM can be compared to vaccination IECMs for previous periods to give an indication of whether child mortality in your area has been falling, constant, or even rising. This in turn will provide information to help plan better services and to identify families at high risk.[4,10]

SUMMARY

- The Previous. Birth Technique can be applied when mothers come to a health facility to have their new child vaccinated.
- Care must be taken so that only live births are included. Previous pregnancies that ended in a stillbirth or miscarriage should not be included.
- Care should be taken to avoid double-counting of mothers who bring their child for more than one vaccination visit.
- Answers to the PBT questions at time of vaccination can be used to calculate an Index of Early Childhood Mortality (IECM). This vaccination IECM can be used to measure trends and levels of childhood mortality at your health facility.

BE CAREFUL!

As we have noted several times above, the PBT is not very complicated, but it is still possible to make mistakes, so you must be careful.

- Before asking the PBT questions, become familiar with the questionnaire. Make sure you understand which questions to ask and which questions to skip. Learn the definition of a live birth.
- There will be different forms and different procedures in each health facility. The examples included in this manual will be modified to fit the local conditions. Make sure you know how the *PBT* will be applied in your own situation.
- Make sure that you get information on the woman's previous live birth. If her previous pregnancy ended in a stillbirth or miscarriage, information about that pregnancy should not be included. Inquire further to find out if she has had a previous delivery that resulted in a live birth, even if the child lived only a short time. Make sure to include all live births, including children who died very early, for example between birth and the naming ceremony. If the woman has not had a previous live birth, do not ask the PBT questions. (Of course, you may collect information on stillbirths and miscarriages elsewhere for other purposes.)

- Collect information only once from each woman. In an antenatal situation, make sure that the woman has not been asked the PBT questions on an earlier visit during the current pregnancy. In a vaccination situation, make sure that the woman has not been asked the PBT questions on an earlier visit to have the her most recent child vaccinated. Do *not fill in the form for second or later visits in either situation.*
- In a vaccination situation, if the mother has had another child since giving birth to the child being vaccinated, do not ask the PBT questions.
- If a woman's previous pregnancy ended in twins, be sure to ask the PBT questions about both twins.

EXAMPLES OF DATA COLLECTION

Here are a few examples of situations where there might be some question about asking the PBT questions.

1) Mrs. A has been pregnant three times. Her first two pregnancies ended in live births, and the children are still alive. The third pregnancy also ended in a live birth, but the child lived only two days, Now Mrs. A is about to give birth again and has come to the BB Health Clinic.

Nurse C asks her the PBT questions. Mrs. A replies "Yes" to the question on previous pregnancies. She then answers "Stillbirth" to the question on the outcome of her previous pregnancy. The nurse is careful, however, and gives the definition of a live birth to Mrs. A, who remembers the child who only lived two days. The nurse then proceeds to fill in the following questions correctly.

If the nurse had not been careful, the death of Mrs. A's last child would have been missed and the IECM for this clinic would have been too low.

Here is how the nurse filled out the questionnaire for Mrs. A:

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PREVIOUS BIRTH TECHNIQUE RECORD FORM AT TIME OF BIRTH

BB Health Clinic

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DATE (Day/Month/Year) 12/09 /94

NAME OF MOTHER Mrs. A.

IDENTIFICATION NUMBER OF MOTHER A000001

==

1. I would like to record some information about your pregnancies. Have you had any previous pregnancies?

___ No [End of PBT questions]

XXX Yes [Go to Question Number 21

2. Was the outcome of your last pregnancy a live birth, a stillbirth, or a miscarriage? ***Wake sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)***

XXX Livebirth [Go to Question 4]

___ stillbirth or miscarriage [Go to Question 3]

3. Before this birth, did you ever have a live birth? ***(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)***

___ No [End of PBT questions]

___ **Yes** [Go to Question Number 41

[The nurse followed the instructions and did not ask this question.1

4. Is your most recently-born child still living? ***(If the previous live birth was actually twins, ask the question and fill in the answers for both of the twins.)***

___ **Yes** Second child (if twins) : ___ ***Yes***

XXX **No** ___ No

==

Signature of recorder: Nurse C

==

2) Mrs. D has been pregnant two times. Mrs. D's first pregnancy ended in a live birth (which is still alive), but the second ended in a stillbirth. Mrs. D is now pregnant again and has come to the antenatal clinic for her first checkup.

Nurse E asks Mrs. D if she has been asked previous birth questions in an earlier visit to the clinic during this pregnancy, and Mrs. D answers "No, this is my first visit." Mrs. D answers "Yes" to the question about previous pregnancies. The nurse then asks her about the outcome of her previous pregnancy, and Mrs. D answers "Stillbirth." The nurse follows the instructions on the questionnaire and next asks if Mrs. D has ever had a live birth. Mrs. D answers "Yes," and answers "Yes" as well to the question about whether that child is still alive.

This case illustrates the important point that stillbirths should not be included in the PBT calculations. The nurse followed the instructions on the questionnaire and identified the previous *live* birth.

Here is how Nurse E filled out the PBT form:

PREVIOUS BIRTH TECHNIQUE RECORD FORM AT ANTENATAL VISIT
FF Antenatal Clinic

DATE (Day/Month/Year) 01/ 12/ 95

NAME OF MOTHER Mrs. D

IDENTIFICATION NUMBER OF MOTHER D00000003

1. Have you been asked questions about previous births on an earlier visit to this facility during this pregnancy?

___ Yes [End of PBT questions; set aside and verify to avoid double-counting]

XXX No [Go to Question Number 2.]

2. I would like to record some information about your pregnancies. Have you had any previous pregnancies?

___ No [End of PBT questions]

XXX Yes [Go to Question Number 3]

3. Was the outcome of your last pregnancy a live birth, a stillbirth, or a miscarriage? *(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)*

Livebirth [Go to Question 5]

XXX Stillbirth or miscarriage [Go to Question 4]

4. Have you *ever* had a live birth? *(Make sure the mother understands that "live birth" does not include stillbirths or miscarriages. Only a child who ever cried or breathed, even if he or she lived only a short time, should be included for PBT.)*

No [End of PBT questions]

XXX Yes [Go to Question Number 5]

5. Is your most recently-born child still living? *(If the previous live birth was actually twins, ask the question and fill in the answers for both of the twins.)*

XXX *Yes* Second child (if twins): Yes

No No

Signature of recorder: Nurse E

3) Mrs. D has returned to the antenatal clinic for a second checkup. The nurse asks her about previous visits to the clinic during the current pregnancy and Mrs. D answers "Yes, this is my second visit." The nurse does not ask the PBT questions. If she did, Mrs. D would be counted twice, which is not desireable.

4) Mrs. G has brought her sister's eight-month-old son to the health centre for DPT vaccination; some months earlier, the child's mother had brought the child in for its BCG shots.

The health aide records Mrs. G's name (as if Mrs. G were the mother) and the child's name and identification number. The health aide then asks Mrs. G if she has been asked questions about previous children on an earlier visit to have this child vaccinated, Mrs. G truthfully answers "No," since the child was brought for its BCG shots by its mother, not Mrs. G. The aide proceeds to ask Mrs. G the PBT questions and fills out the form correctly (Mrs. G's most recent child was still alive).

Later, the health aide checks the child's identification number against her list of children who had received BCG shots just after birth, and discovers that the child's mother was already asked the PBT questions at that time. The questionnaire is discarded, since the answers were about Mrs. G but Mrs. G was not bringing her own new child for vaccination.

This example illustrate several points. First, it shows how easily false information might enter the PBT procedure if health workers are not careful. If you are in a situation where children do not have identification numbers or where it is not easy to check records for identification numbers, the woman accompanying the child should be asked if she is the child's mother. If she is not, the PBT questions should not be asked.

Secondly, suppose the child had been brought in by its mother for the DPT vaccination. It would be important to get correct information about the earlier vaccination visit with the same child. PBT information would have been collected at the first visit, so none should be collected at the later visit.

SUMMARY

In order to collect accurate information:

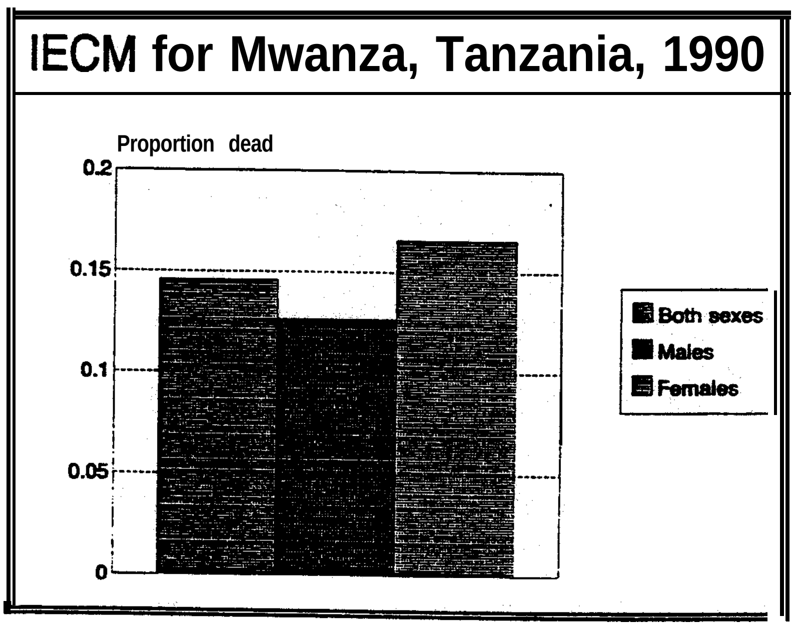
- Follow the instructions on the questionnaires carefully.
- Understand the exact information the PBT is 'trying to get: whether the previously live-born child is still alive or not.
- Be alert for the possibility of double-counting in the antenatal and vaccination situations.
- Do not treat stillbirths and miscarriages as if they were live births. You may be collecting information on stillbirths and miscarriages on other forms for other purposes, but they are not part of the PBT.
- Any child who ever cried or breathed, even if he or she lived for only a short while, should be included for the PBT.

EXAMPLES OF IECMs

Here are a few graphs of the results of applying the PBT in other places. Graphs of the data you and your co-workers collect will look similar but, of course, the actual numerical values will be different.

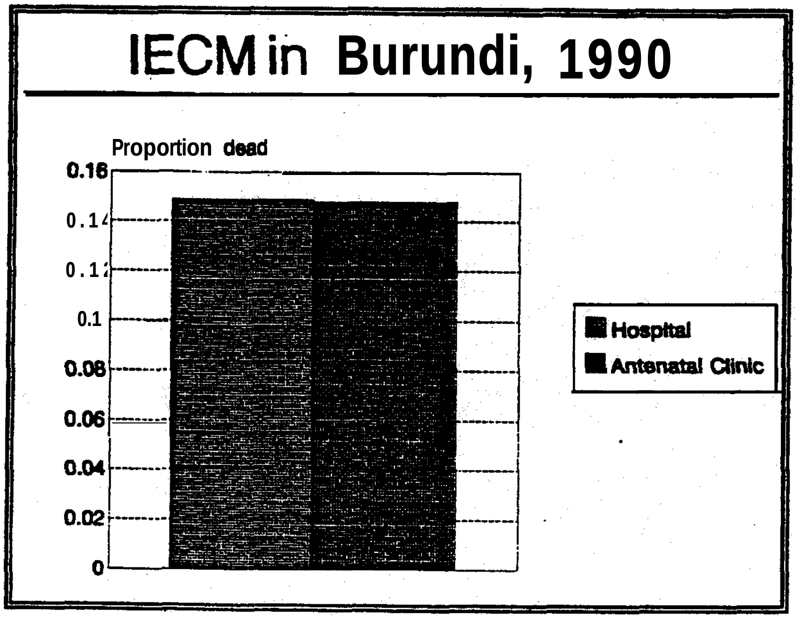
Tanzania

The first graph is from a pilot study in Mwanza Region, Tanzania. The data are from one period only. A question on sex of previous child was included in the questionnaire, so the IECM can be presented by sex.



Burundi

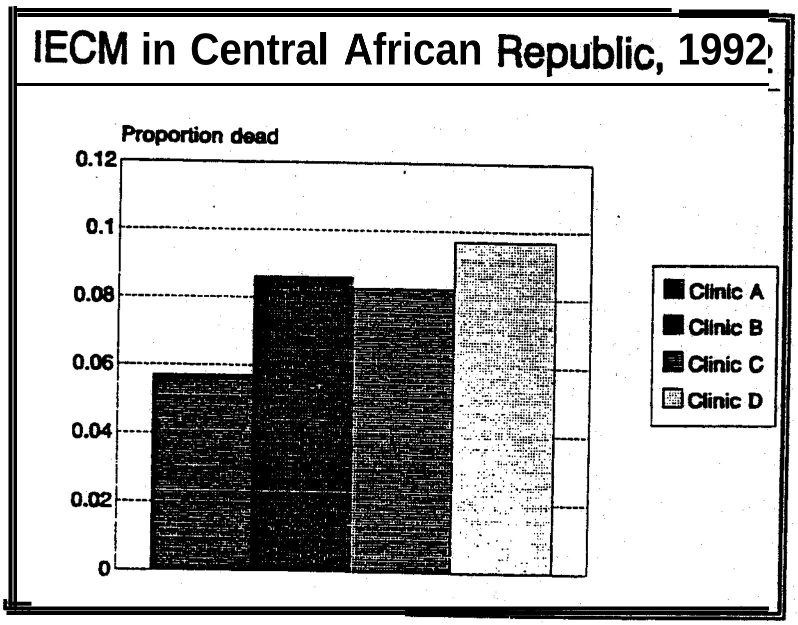
In Burundi the PBT was tested in a hospital maternity clinic for women giving birth and in an antenatal clinic. Over 1,000 women were interviewed in each place; 31 percent of the women at the hospital and 23 percent of the women at the clinic were giving birth for the first time and hence were not asked the PBT questions.



It is important to note that the two sites for the Burundi trial were for different situations, i.e., an at-birth situation and an antenatal situation. ***In general it is not a good idea to compare data from two different situations like this without extreme care.*** One important reason is that previous birth mortality would be expected to be lower in the antenatal setting, since the interval from previous birth to the time of interview would be substantially shorter. In Burundi, the average interval for the antenatal clinic was almost four months shorter than the average interval for the hospital maternity clinic."

Central African Republic

In the Central African Republic the PBT was tested in four urban clinics in the city of Bangui. Of the women registering births at the clinics, 27 percent were giving birth for the first time. As you can see, the IECMs for the four clinics varied considerably.



NOTES

1. More precisely, the results refer to a period some months before the period of data collection. This issue and others relating to the more technical aspects of the PBT are discussed in Part II of the manual.

2. The previous birth technique works best when all or most new mothers are included. If fewer than half are included, the results are not likely to be a good measure of child mortality in the community.

3. If certain conditions are met, the <u>level</u> of childhood mortality can also be calculated: the IECM is approximately equal to the chances that a newly-born child will die before reaching its second birthday. The conditions are discussed in more detail in Part II of the manual.

4. A detailed discussion of the many ways in which the results of the PBT can be used is found in Part II of the manual.

5. The question on previous pregnancies is included in our examples to guarantee that previous births that died soon after birth are counted. For various reasons, women may omit mention of such births. A question on pregnancies is more likely to elicit information on such births. If in your situation information is already collected on previous pregnancies, so there is no chance of missing very early childhood deaths, the previous pregnancy may be deleted from the PBT questions.

6. In some places, such as a trial that 'was done in Tanzania, women who had given birth within 24 hours before registering are also included. Whether such women and such a time period should be used by you will be made clear by your supervisors.

7. The PBT questions are restricted to live births only. You may be collecting information on stillbirths and miscarriages elsewhere for other purposes.

8. As noted above, eventually the questions will be included on the standard questionnaire you use.

9. The interval will vary depending on the circumstances. One of the important factors is how many births have been recorded in a period. There is a certain minimum number of births, roughly 1,000, needed to make the PBT estimates of child survival accurate. See the Part II of the manual for more details.

10. The IECM for your health facility is not necessarily comparable to the IECM for other places. It is useful primarily

as a way of finding out what recent childhood mortality trends have been in your area. IECMs are less useful for comparisons, because important factor6 which affect the calculation6 (such as birth interval) may differ from place to place. Thus, IECMs from other areas or those collected in your area during antenatal or postnatal visits should not be compared with the IECMs from your at-birth data without great caution. This issue is dealt with in some detail in Part II of the manual.

11. Note: if identification numbers are not used, or if it would be hard to check later to see if the child had been to the clinic before, it would be useful to ask the woman accompanying the child if she is the child's mother. If she is not, the PBT questions should not be asked.

12. The effects of birth interval length and other factors on the IECM are discussed in detail in Part II of the manual.

CHAPTER I. INTRODUCTION

Aims of this handbook:

This handbook is meant to improve the management and assessment of child survival programs in developing countries. Often, the obstacle to more effective program implementation is the lack of relevant and up to date information on past achievements or current needs. When vital registration data are incomplete, inaccurate or entirely lacking, program managers are forced to resort to a variety of different strategies including guesswork. Very often, information on child survival is derived from the analysis of census data: from information contained in major household surveys such as the Demographic and Health Surveys (DHS); or program managers may have to conduct special surveys themselves. There are both advantages and drawbacks associated with using information from these different sources - some of these are described later. The main point here is that once the data on child survival are being generated on a routine basis as a part of the programs themselves, then it will be possible to tailor more closely new program initiatives to needs and to better judge past failures or successes.

In this handbook, we set out an approach to the assessment of child survival trends in developing countries using a continuous monitoring approach based on the Preceding Birth Technique, the PBT. This method allows us to generate running estimates of child survival for districts and for sub-populations. Other methods will usually be preferred for making national-level estimates. With the district-level approach, professionals associated with the program activities themselves are able to monitor the impact of their work without having to call in other specialists. The results are readily interpreted even to those with only a modest training in statistics or demography. And the data collection process itself can be fitted into the scheme of patient management since the indicator in question, the survival status of the preceding born child, has meaning both to the health professional examining the individual mother pregnant another time, and to planners interested in the level and trend in early childhood mortality in the wider community.

Why measure childhood mortality?

Despite ail the technical shortcomings, measures of change in infant and childhood mortality remain very influential indices of program achievement. In future, when information systems improve, cause-specific mortality and morbidity may supplant overall childhood mortality measures but for the moment, early age mortality is the preferred index. One irrefutable advantage of measures of gross changes in childhood mortality is that improvements due to a large number of factors - health, economic and social developments - should all contribute to a rise in child survival probabilities. In epidemiological terms, the problem with the childhood mortality measures is that they are very non-specific and may also be insensitive to specific inputs in the short-term from a particular sector.

In summary, therefore:

- child mortality levels and trends are good summary measures of health and mortality and the overall welfare of the population at large;
- child mortality indices capture the gross effects of both health interventions and other factors (positive and negative) which affect child survival:
- compared to other measures of welfare, child deaths are common and numerous so that rates can be readily calculated for sub-populations, provinces and districts;
- childhood mortality differentials can provide valuable insights into the pattern and distribution of disparities in family and community health;
- involvement of health and community workers in data collection and analysis can spur local action;
- quantitative outcome measures are more persuasive than impressions or process measures;
- identification of vulnerable groups is an essential part of the overall decline in mortality.

In this guide, we focus on the technical problems of measuring short-term changes in child survival using simple methods and routine data. There are other texts which describe the collection and analysis of census and survey data on childhood mortality (eg... UN , 1983; David, Bisharat and Hill, 1990; and UNICEF, 1995). For those contemplating a special survey, please refer to Appendix 1 which provides further readings on recent experience with such measures. The stress in this manual is on the detection of short-term reiative changes at the district level rather than the generation of national 'level data for which other methods are probably more appropriate.

What methods can health workers use to measure childhood mortaliiy trends and differentials?

- **National and local estimates of childhood mortality should ideally come from current vital registration data in conjunction with denominators from a full population census. In most developing countries, data from these sources are usually lacking or of poor quality.**

- **This information gap is generally plugged by conducting large, nationally representative sample surveys such as the studies conducted under the World Fertility Survey or the Demographic and Health Surveys programs. These data are often out of date (due to the size and complicated nature of such surveys) and cannot be disaggregated to small districts since they are national probability samples.**

- **Simpler surveys, using variations on the standard WHO EPI coverage cluster sample surveys with an additional set of questions on childhood mortality, have been tried in more than 10 countries with encouraging results.[1] The same surveys were also used to make indirect estimates of maternal mortality. These surveys do not meet all of the needs of health providers since they still require additional resources to mount and analyze and are more complex to run than the basic EPI coverage survey.**

- **A simpler option is now available - the Preceding Birth Technique or PBT. This involves asking mothers about the survival of the previous birth. Three possible moments close to the time of a birth have been identified as suitable for the collection of these data:**

  a) at the time of a subsequent delivery;

[1] Reports on these surveys are available in: PH David, L Bisharat, and S Kawar (1991) "Using routine surveys to measure mortality: a tool for programme managers", Social Science and Medicine 33(3): 309-319; PH David and AG Hill (1992) "Childhood mortality measures for programme needs"; paper presented to the WHO Technical consultation on childhood mortality and causes of death, Geneva.

about other kin such as the children's fathers and other household members. It is partly to add this additional information that countries with full vital registration add national sample surveys, both cross-sectional and panel or follow-up surveys, to their routine data collection activities.

Recently, a number of experiments have been conducted in order to produce short-cut methods for measuring childhood mortality levels, changes and differentials in countries where resources, human and financial, are very restricted. The main question is whether such simplified methods are good enough (see criteria above) to serve our needs until the full panoply of data collection systems is in place. Before proceeding, it must be pointed out that even the best-tried and theoretically sound methods can at times produce poor results. The core of the problem is the establishment of a good relationship between the interviewer and the person interviewed. If this breaks down or is undermined by outside factors such as misunderstanding or suspicion of the motives for the survey, then the resulting data will be untrustworthy. Of course, poor questionnaire design, incorrect sampling procedures and sloppy coding and data entry procedures can all play their part, but paramount is the creation of trust between the person providing the data and the interviewer.

There are other reasons for developing the local capacity to assess childhood mortality trends. We need only mention briefly here, since these goals are not the subject of this paper, the importance of such work for essential national health research; for building capacity; for community participation; and to broaden the debate on the essential elements of "Good Health for All".

Routine sources of information

The data from fixed collection points are extremely varied and include the following:

a. Partially complete registration data, often from urban populations. In some francophone countries, death data are often collected by the Service d'Hygiène, part of the Municipality or the Ministry of Health, whilst the formal civil status data are often the responsibility of the Ministry of the Interior. There are many examples of good analyses of incomplete vital registration data; the Service d'Hygiène data for some African capital cities have been used ingenuously by Fargues and Ouaidou (1.988) and by Fargues and Courbage (1986). Generally, the problem with such data is the estimation of the direction and magnitude of the selection bias.

b. Hospital or clinic data are less attractive since they suffer from severe selection bias which may change over short periods. They are often the only source of information on exact age at death or on cause of deaths as judged by medical professionals.

c. Data from delivery rooms and maternity clinics. Where substantial proportions of women deliver in such centers, the data on birth weights, characteristics of the mothers delivering, and on the survival of previous children can provide a good guide to trends in the general population. Where very few women deliver in such centers, the data can be misleading due to severe selection bias.

d. Data from women seen before or after the birth of a child. Here we refer to the attempts by countries such as the Sultanate of Oman and The Gambia to gather information on the survival of previous children from women during ante-natal examinations and immunization or at first immunization following a home delivery.

e. Vital registration from sentinel sites or from surveillance areas set up to evaluate the mortality impact of a particular health intervention. The Matlab Thana study of the ICDDR-8 is the best known of these but newer studies include the surveillance of all childhood deaths in Bassé, eastern Gambia, to assess the efficacy of a pneumococcal vaccine; the study of 5 large areas in rural Gambia to evaluate the impact of the national impregnated bed-net program; and the Navrongo vitamin A trial site in northern Ghana.

The data collected routinely have several major advantages over the aggregate information obtained in surveys. One important technical point frequently overlooked is that program managers are generally more interested in period rather than cohort mortality measures. The Brass methods of indirect estimation produce a kind of hybrid measure by averaging births and deaths over periods preceding the survey. Often, when full birth histories are collected, it will be cohort rather than period mortality which is presented, although in the WFS and the DHS reports, Rutstein was careful to calculate true period measures. In the evaluation of some interventions, it may well be that cohort measures of mortality improvement may be more appropriate. For example, measles immunization appears to confer lasting benefits on those immunized compared with those exposed to the wild virus. Some thought needs to be given to the relative importance of period versus cohort measures when evaluation studies are being designed.

Interpreting childhood mortality measures and changes

Examination of any reliable time series of data on childhood reveals several important features:

* **fluctuations in child survival from year to year are substantial even in large populations;**

* **there is often a strong seasonal trend superimposed on the secular annual trend;**

* **variations in neonatal mortality, post-neonatal and infant mortality as well as the mortality of older children (1-4 year olds or even 5-9 year olds) are often independent of each other.**

Opportunities and suggestions:

For the health sector, more relevant and more current data may be obtained through the health services than from large-scale demographic surveys. In addition, progress with the improvement of vital registration data is very slow. Working to make the health information system more streamlined, to obtain relative data, and to strengthen local capacity to assess and evaluate the effectiveness of their the health services are important additional goals. In this manual, we describe how to install, manage and analyze the Preceding Birth Technique in three different setting:

1. **Include the PBT questions** on all maternity clinic records

In many places, the survival of the preceding child is already being collected in delivery room books or on cards held by mothers. The only additional work will, involve systematizing the format of the questions put to mothers (see Appendix 1); making plans for collection of the raw data; and training health workers to use the data effectively. There are many additional benefits to both mothers and children from collecting the data in this way (family risk identification; patient management; facilitating enquiries into adverse outcomes etc).

2. **Where a** majority of pregnant mothers visit ante-natal clinics, add the **PBT** questions at first visit

A simple tally of the numbers of preceding children dead made from mothers

attending for tetanus toxoid immunization or the like towards the end of their current pregnancy may be the best

3. **Collect** the data when mothers bring their most recent born children for immunization

Without doubt, the health intervention which reaches the largest fraction of mothers in developing countries is childhood immunization. Whilst 57% of women in developing countries received tetanus toxoid in 1990-91 and 55% of mothers delivered with the assistance of a trained health person, 84% of all children were vaccinated with BCG soon after birth. The question is how best to add some additional questions on child survival to a system established principally to deliver vaccines to young children.

What can programs do with PBT information?

The routine collection of PBT data for management begins at the first level of patient contact with the health service. This information can be passed to higher levels to meet reporting requirements. The information can be used at the point of collection to monitor, evaluate and reform services delivered at the district, regional or national levels. For some purposes, additional questions on the characteristics of the family or the circumstances of the death may be useful (see' above).

Some uses:

* Managers can use the data to identify problem areas where a special focus is needed. Does the information reflect problems with service delivery?

* The information can be used to understand better the distribution of risk or differential risks among the population in the catchment area.

* Family risk assessment to improve/set targeting strategies to reach high risk groups.

* Individual patient management and follow-up of high risk mothers.

* Case investigation of adverse outcomes - were these missed opportunities? (eg. was the mother immunized against tetanus before the birth? Was the child immunized? Did the mother use the health services at any time during pregnancy or preceding the child's death?)

* Cause of death inquiries may become possible, especially when these data are obtained by health clinic staff.

* Clinic staff can be involved in evaluation of services; can build capacity for local and higher-level monitoring. Health information system reform may be accelerated by involving health workers more in the use, and application of the data.

* Data can be used to advocate for increased resources from public expenditures and to provide information on re-allocation needs.

* Information on clinic and district mortality rates can be used to increase local awareness and involve district health committees and organizations in setting priorities for community health services.

CHAPTER 2: DEFINITIONS AND SOURCES OF INFORMATION ON CHILDHOOD MORTALITY

A. Introduction

This manual focuses on the Previous Birth Technique (PBT), a simple and useful way of obtaining up-to-date information on child mortality. Before beginning our discussion of the PBT, however, we will spend a few pages describing commonly used measures of child survival and child mortality. Following that we will discuss the sources of data needed for calculation of these measures and what can done when these sources are inadequate in some way. This will lay the foundation for our discussion of the PBT.

B. Common measures of child survival

When studying child survival and child mortality, the central index we are trying to measure is the probability that a newly-born child will live to a certain age or, conversely, die before a certain age. The "certain ages" are commonly chosen as one, two, and five, although any age could be used. While probabilities are our preferred measure and probably the measure most easily understood, in some situations we may be faced with data in slightly different forms, such as death rates, which are sometimes used as they are and sometimes translated into probabilities. We list below the definitions of the most common measures and some of the relationships among them.

1. Definitions

a. A probability of death (survival) is the-number of individuals dying (surviving) during a period divided by the number of individuals alive at the beginning of that period and exposed to the risk of death. Probabiiities are sometimes called "risks" [David, Bisharat, and Hill:1 61. Probabilities can be specific for any number of characteristics, such as age, sex, marital status, rural- urban residence, etc. In this booklet our discussion will concentrate on the probabilities of death between birth and age one [written as q(1)], age two [q(2)], and age five [q(5), also known as U5MR, the under-five mortality rate]. These probabilities can be measured or estimated in various ways, which we will explore below.

b. A death rate is the number of deaths during a given period divided by the mid-period number of individuals exposed to the risk of death. For example, the commonly encountered crude death rate is defined as the number of deaths in a population in one year divided by the total mid- year population.

$$CDR(t) = D(t)/P(t)$$

where CDR(t) is the crude death rate for year t, D(t) is the number of deaths in year t, and P(t) is the population at the middle of year t. To calculate death rates, accurate counts of both numerator (deaths) and denominator (population) are needed; such counts are not always routinely available, which is why this booklet exists. As with probabilities, death rates can be specific for various characteristics.

c. The infant mortality rate (IMR) is defined as the number of infant deaths in a given year divided by the number of births in that year:

$$IMR(t) = D(0,t)/B(t)$$

where IMR(t) is the IMR for year t, D(0,t) is the number of deaths to infants in year t, and B(t) is the number of births in year t. While the IMR is not a pure probability, in the absence of exceptional conditions it is usually accepted as measuring the probability of death before exact age one, i.e., q(1). The IMR can be specific for sex, residence, education of mother, etc., always depending, of course, on whether the requisite data are available. "The measure most often used is the infant mortality rate.. ." (Hill,K., 1991:368).

d. The under five mortality rate (U5MR), also written as q(5), is the probability of dying before exact age five for a group of children all born in the same period. The U5MR is often used instead of the IMR to measure child mortality. This is because

In some countries, where vital registration are lacking, precise birth and death dates are not availabie. We 'know that mothers have a tendency to 'round' their children's ages to whole years. This results is some less precise estimates of death rates at young ages, but most of these -errors can be avoided if we look at under-five mortality as a whole. Another reason to use under-five rather than under-one mortality is that intervention are often aimed to reduce deaths due to environmental hazards, diseases prevented through immunization, and diarrhoea, which particularly affect survival of children over one. (David, Bisharat, and Hill, 1990: 17-l 8)

Said another way:

"[I]n most developing-country contexts of high child mortality, as many as 50 percent of all child deaths may occur after infancy, and a broader measure, such as the probability of dying by age five,christened by UNICEF the "Under-5 Mortality Rate," is preferable to the infant mortality rate" (Hill, K., 1991:368).

2. Typical levels and relationships

Table 1 shows typical values for the IMR, q(2), and the U5MR for countries experiencing low, medium, and high levels of mortality; the overall level of mortality is indicated by the life expectancy, e(0). Note that the relationships among the countries for the different measures are almost always the same: if q(1) is higher in country A than country B, so too will be q(2) and the U5MR. This reflects the fact that the shape of the mortality curve by age is roughly similar in all populations: high mortality populations have high death rates and high probabilities of death at all ages, low mortality populations have low death rates and low probabiliiies of death at all ages. Figure 1 shows typical mortality curves for low and high mortality populations.

The various measures of mortality are intimately related. For example, the death rate for ten-year-olds (children aged ten last birthday) in a population would be defined as the number of deaths to ten-year-olds divided by the mid-year population of ten-year-olds. The one-year probability of death for ten-year-olds would have the same numerator but a different denominator: the number of children who had reached their tenth birthday. Since the denominator of the probability is larger than the denominator of tlie rate (deaths in the first half of the year are not included in the denominator of the rate), probabilities for single years are always smaller than the corresponding rate. (For five-year or other size age groups, the probability is much larger, since it refers to a period of five-or other number– years, while the rate refers to one year [David, Bisharat, and Hill: 17]). This won't concern us much since when using the PBT we will be dealing mainly with probabilities.

C. Sources of data

1. Ideal sources of data

Ideally, the measurement of mortality and survival involves utilizing data from two sources: a count of the population (i.e., a census) to establish the size of the denominator population at risk, and a count of events -deaths- from a registration system for the numerator. With such data we can calculate death rates and, if desired, convert them to probabitiiies of death and survival through use of life table procedures.

"The continuous registration of births and deaths is potentially the richest source of data about child mortality. IF registration is complete, the IMR for each year can be calculated in the conventional manner directly from the system's data, thus providing information on level and detailed trend in the IMR... the IMR can be collected for small areas, and ... socioeconomic mortality differentials can be obtained" (Hill, K., 1992:369).

"Unfortunately, very few less-developed countries (LDCs) have vital registration systems that approach the ideal... In some countries with largely complete coverage, delayed registration may be a problem that affects the timeliness of the measures.._" (Hill, K., 1991: 369). The ideal data are often not available, and when they are available they are not necessarily complete or accurate, so various methods have been devised to enable the estimation of the desired measures. Several such approaches are described briefly below (section D), after we first describe the basic data sources which have conventionally been used to provide information on child mortality. [Note:

these sources not necessarily designed primarily or especially for the collection of child mortality data. They may be ad hoc efforts set up to collect other health-related information and non-health-related information as well.]

...in many countries where child mortality is of most concern, neither the numerators (the deaths by age), nor the denominators (the population at risk) for conventional death rates are available. This is true when the death registration system does not cover all the deaths occurring and when there may be only one, outdated, full population census. Even if these data are available, selective omission from the registration of certain groups (for example, groups on the margins of society, such as nomads or squatter- settlement inhabitants, and newborns dying soon after birth) and sever age-misreporting can seriously bias estimates from this source.

Health service based statistics suffer from similar limitations, since they may include only deaths occurring in hospitals or clinics. Biases in the estimates from the sources are often found because the entire population does not use the health services equally. There is another problem in that the population base for calculating rates, the denominator of the rate, is often unknown or difficult to determine. The events (death or disease incidence) counted by hospitals and clinics come from an undetermined population.

Multi-round and longitudinal surveys, though useful in some contexts, present their own problems of extra cost, loss to follow-up, and waiting time which must be allowed before estimates of morality can be derived.

In addition to these drawbacks, health planners need annual rates which refer to periods of time as close as possible to the current period so that recent trends can be closely monitored. Registration system or health service statistics often suffer from long time delays between collection and publication. (David, Bisharat, and Hill, 1990: 18)

2. Sources of data when the ideal sources are not available or not adequate

"Attempts have been made in many parts of the world to improve deficient vital registration systems, but these attempts have by no means all been successful. A typical strategy is to introduce a new or improved registration system... in a small number of sample areas... " (Hill, K., 1991: 370).

a. Censuses

If accurate data on events (deaths) are not available for a population but the country does conduct a census, the census can be utilized to gather some information on mortality. The most commonly collected information comes from questions asked of women on numbers of children ever-born (CEB) and numbers of children surviving (CS). Indirect estimation techniques (see section D, below) can be used to translate figures on proportion of children surviving (CS/CEB) into standard life-table probabilities of dying. Estimates of child mortality obtained in this way from censuses generally refer to the period of 15 or so years before the date of the survey, with estimates for the most recent five years being the least reliable.

b. Sample registration areas (HM, 1985:6)

"Attempts have been made in many parts of the world to improve deficient vital registration systems, but these attempts have by no means all been successful. A typical strategy is to introduce a new or improved registration system... in a small number of sample areas... A successful example of this strategy is the Indian Sample Registration System, which. now provides apparently satisfactory estimates of vital rates for almost all the states of the country" (Hill, K., 1991: 370).

If a country, for whatever reasons, does not have a vital registration system that provides accurate counts of deaths in the population, a sample registration system may be developed. In such a system, certain representative areas of the country are chosen and major efforts are made to establish a complete and accurate registration procedure in these areas (such efforts are not, of course, always successful, even on a small scale, at least at first). For example, suppose District A, with a population of 10,000, is considered to be representative its province, which has a population of 1.5 million. If a complete registration system is set up in District A and registers250 deaths in one year, for a crude death rate (CDR) of 250/10,000 or 25 per 1,000, and if District A is representative of the province, then the assumption is made that the CDR for the whole province is approximately 25 per 1,000. Sample registration districts in other provinces might provide different levels of mortality for their respective areas.

Such an approach requires that the sample areas be reasonably representative of the larger areas in which they are situated; it also requires data for the denominator, i.e., the mid-year population at risk. If a current accurate census is not available for the sample areas, then a special census must be taken or an estimate of the population must be made.

Sample registration systems provide data in the same form as do the national systems in countries with better data. That is, deaths (and births) are counted for the numerators of rates and a count of the population is used for the denominator. information on characteristics such as age, sex, etc., can also be collected to produce death rates specific for these characteristics. No indirect procedures are required for the calculations.

The best known example of a sample registration system in action is that of India, where the system was established in 19??... Several examples exist in Africa as well. A major appeal of the sample registration system approach is that it can be regarded as an important step towards the creation of a nationwide registration system.

c. Sentinel sites, population laboratories (Gambia malaria trials-see Bill's thesis)

"A close relative of the multi-round survey is the surveillance system, whereby a geographically defined population is kept under detailed study for an extended time period. The best-known example of a surveillance scheme is the International Centre for Diarrhoeal Disease Research study of Matlab thana 'in Bangladesh... but smaller systems also exist in Senegal, the

Gambia, and other places. The key characteristic of a surveillance system is a defined geographic area, the population of which is visited at frequent intervals, even as often as once a week, to inquire about demographic events, morbid episodes, contraceptive use, or whatever may be the focus of a particular study. From time to time, often several years apart, census of the system's population are taken, to check the population denominators needed to calculate age- and sex-specific rates and to evaluate registration coverage. The surveillance system can generate excellent measures of levels, age patterns, and differentials of child mortality for the study population_ Trends can also be measured over the life of the system... [Surveillance systems1 are extremely expensive,: subject to instability, and are "unable to provide quick measures because time is needed to build up sufficient events and exposure to risk to calculate stable rates. Further...it will become less and less representative as time goes by... " (Hill, K., 1991: 370-371).

Perhaps the best-known example of a population laboratory is Matlab in Bangladesh:

The Matlab demographic surveillance system (DSS) has been maintaining records of vital events of over. 200,000 people (1993 population) since 1963.. . [D]irectly measured mortality and migration rates are available from the continuous recording system. Pregnancies are systematically followed so omission of births and deaths is rare. Data on exact age at birth and death and hence on birth intervals are also available. Altogether, the existence of such detailed information on a large scale is unique in the developing world. (Bairagi, Shuaib, and Hill, 1995: 7)

In such a situation, there is no problem in calculating any desired measures of child mortality and child survival, and indirect approaches are not required. The resulting figures may not be representative of the country as a whole, but they are very accurate for the laboratory population. Furthermore, the detailed records allow researchers to explore alternative indirect approaches to mortality measurement. In particular, as we will describe below, data from Matlab have been used to compare measures calculated with the 'use of the PBT with more directly calculated conventional measures.

d. Multi-round surveys and surveillance systems.

"[M]ulti-round surveys use repeated visits to households in sample areas to record demographic events... follow-up rounds typically at intervals of six months or a year . . collect information about demographic events since the previous round... They cannot . . provide estimates of trends prior to the period of fieldwork.. . The amount-of background information that can be collected is limited only by the availability of resources" (Hill, K., 1991:370). "Multi-round surveys.. . can generate excellent measures of levels, age patterns, and differentials of child mortality for the study population. Trends can also be measured over the life of the system... [Multi-round surveys]... are extremely expensive," subject to instability, and are "unable to provide quick measures because time is needed to build up sufficient events and exposure to risk to calculate stable rates. Further...it will become less and less representative as time goes by..." (Hill, K., 1991: 370-371).

e. Sample surveys (large (DHS) or small (UNICEF or WHO))

"The most widely used substitute for a complete and timely vital registration system is the incorporation of questions in a cross-sectional data collection procedure asking women about the survival of some or all of the children they have had.. ." Hill, K., 1991: 371).

Sample surveys are similar to censuses in that they collect data at a point in time, rather than continuously as a registration system does. Sample surveys are often undertaken with specific goals in mind, so that more detailed information on certain subjects can be collected. In the case of child survival and child mortality, sample surveys can collect full birth or maternity histories from mothers. Data from such histories allow use of life-table methods to calculate measures of child mortality and also a modified version of the PBT (for examples of both of these, see David, Bisharat, and Hill, 1990; David and Hill, 1992: 12; David, Bisharat, and Hill have a whole booklet on mortality' within surveys: see esp. pp. 15-22; and pp. 105-l 09 for

PBT, 85-95 for life-table approach; 95-105 for Brass approach; 11 O-l 15 for use of a short birth history). Data for the CEB/CS approach can also be collected (see below). Estimates of child mortality from sample surveys generally refer to the period of up to 15 or so years before the date of the survey with estimates for the most recent five years being the least reliable.

Sample surveys are usually taken with the goal of representativeness in mind. Whether small-scale (district or smaller) or large-scale (national), the survey sample populations are chosen to be representative of the larger populations. Because of the fact that they are small samples of the total population and because they are one-shot efforts (or repeated one-shot efforts), sample surveys are not necessarily able to collect data on very small areas. In addition, they require major efforts in preparation, fielding the survey, and data processing and analysis.

f. Dual registration schemes (Chandra-Deming (see paper from IUSSP series, which Allan will send))

Because of the danger of data omission in both sample registration schemes and sample surveys, there have been several attempts to combine the two approaches for the same sample areas, most notably in India and Pakistan. A fairly simple mathematical formula allows the calculation of events which both systems may have missed, producing estimates of the amount of under-reporting and of the "true" rates. Dual registration systems have been pretty much abandoned [??] in favor of stand-alone sample registration systems (India) or occasional sample surveys (Pakistan).

D. Indirect approaches

As noted above, when the ideal data for measuring child mortality are not available, other data can be utilized for estimating basic measures. The approaches utilizing such data are sometimes called "indirect estimation techniques," since many of them do not directly count the number of events and number of people for the total population. In this section we present brief discussions of the methods most useful for estimating child mortality and list some of their advantages and weaknesses for this task.

1. CEB/CS (HM,1985:3-4; Hill, K., 1991: 371-372)

The method of mortality estimation through use of census or survey questions on children ever born (CEB) and children surviving (CS) was originally developed by William Brass (Brass et al., 1968; U.N., 19671, and such questions have become known as "Brass-type" questions. The basic idea is that the ratio of CS to CEB is a measure of child survival. For young women it measures survival for very young children in the very recent past; for older women it measures survival for children to older ages and over longer periods into the past (cf Feeney, 1980, and Brass, 1982, both cited in Hill and Macrae, 1985:3). Calculation of CS/CEB for women of different ages allows insights into the survival of children to different ages. The procedure requires the use of model life tables, since the measures generated are not in conventional form. (For more details on this method, see David, Bisharat, and Hill, 1990: 19-22; Hill, 1991; and United Nations, 1983; for refinements, see Sullivan, 1972; Trussell, 1975, both cited in Hill and Macrae, 1985:3.)

The method has several important features (Hill and Macrae, 1985:4). First, cost is low: only two questions are needed on a census or survey questionnaire. Second, calculations can be made quickly and easily with the use of a hand calculator. Third, questions needed are short and simple. Fourth, estimates of mortality for periods of up to 15 years in the past can be obtained.

Although extremely useful in providing mortality data where none would otherwise exist, the CS/CEB approach nevertheless has drawbacks for some purposes (Hill and Macrae, 1985:4). First, measurement of short-term recent changes, such as those expected following the introduction of an intervention program, are not easily caught. Second, estimates of recent mortality for young children are based on data from young women, whose births are primarily first-order; if child survival varies with birth order, this poses a problem [David and Hill: 12,141. Third, as noted above, model life tables are needed to produce estimates of mortality using conventional indexes; model life tables are not always available and are not intuitively understandable by some people. The choice of a model is critical, yet it can not always be made with assurance. Fourth, the method assumes that fertility has been roughly constant in the recent past and that child mortality has been changing linearly in the recent past (Hill, K., 1991: 371). Fifth, misreporting of age by mothers and omission of births can effect the results. Finally, a sample of at least 1,000 women is probably necessary to ensure that the sampling error of mortality estimates is not too great.

2. Maternity histories (HM, 1985:4-5; K. Hill, 1991: 373-374)

"Maternity history surveys have proved to be a very important source of information on levels, trends, age patterns, and perhaps most significantly, associations with social, economic, and biological factors ... of child mortality" (Hill, K., 1991: 374). Maternity histories collect direct information on births and deaths but not, of course, on the total population size. The collection of complete maternity or birth histories involves a large investment in time, training (of female interviewers), and money. Thus, they are not usually part of a census questionnaire. When included on a sample survey, however, they can give good results. An important feature is that model life tables are not needed, since life table methods can be used to calculate the probabilities of dying by certain ages directly [Hill and Macrae, 1985, refer to the SPSS Manual, 1983, chapter 40, for details; step-by-step instructions are given on pp. 110-116 of David, Bisharat, and Hill]. "The more demanding of life table estimates based on the short birth history advise against use of this method in such circumstances [as Jordan and Djibouti]" (David, Bisharat, and Kawar: 315).

The use of maternity histories does have its drawbacks, however (Hill and Macrae, 1985:4-5). First, interviewers must be carefully trained to collect accurate and complete information. Second, fieldwork is difficult, with interviews taking a considerable amount of time. Third, as with the Brass CS/CEB approach, estimates of mortality are not for the immediate pre-survey period. Fourth, rounding of ages of death is prevalent, which makes it difficult to calculate an IMR satisfactorily

(Hill, K., 1991: 373). Finally, analysis is difficult. Data files may be quite large and an adequate computer with'the correct software is required. This means that results may not be available for many months after the survey.

3. Follow-up studies (HM,1985:5-6)

In theory the idea of following a birth cohort of children and observing their survival experience is attractive. Data on mortality can be readily calculated, and other related information, such as cause of death, sickness, growth monitoring, etc., can be collected. However, there are major drawbacks to this approach to measuring child mortality. First, such studies are costly and difficult, hence often have a limited life span. Second, drop-out rates because of inability may be high. Third, the effort must be maintained for many years if usable results are to be obtained. Finally, even the most ambitious effort cannot really cover a large proportion of the population, and the representativeness of the results may be doubtful.

Note that, because some omissions will occur under the best conditions, estimates of mortality that are based on retrospective questions should be seen as minimal estimates of the true mortality levels [David and Hill:22].

Bridging note: the above sources are all more or less "demographic," run by researchers, "non-routine." There are other sources of data on the health of a population, of course, collected by the health service system of a country. Such data sources have traditionally not seen as good sources of accurate and reliable information on levels and trends of mortality because of problems of representativeness and because the system provides no information on the population at risk, the denominator needed for any calculations of rates and risks. However, there is one approach which can be applied within the health services system of a country to provide not only good but also very timely information on child mortality. This is the previous birth technique (PBT), to which we now turn. (Dennis Lury's Data Collection and Analysis is a good example of simple explanation).

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CHAPTER 3: THE PRECEDING BIRTH TECHNIQUE EXPLAINED

A. Introduction

Suppose in one year in District A, 1000 women gave birth to second or higher order child. When asked about the survival of their preceding births, 250 of these women said the children had died, 750 said the children were still alive. We could say that P, the probabiiity of survival for the preceding births, was .750 and that Q, the probabilii of dying, was .250.

Suppose five years later 1000 women in District A gave birth to second or higher order births. When asked about the survival of their preceding births, 200 of these women said the children had died, 800 said the children were still alive. We could say P was .800 and Q was .200.

From these observations it seems probable that childhood mortality had fallen in District A, because lower proportions of children were dying between birth and the birth of their following siblings, i.e., Q had fallen and P had risen.

This is the basic reasoning behind the previous birth technique (PBT), which we explore in this booklet. Everything else about the method (and there is a lot more) is simply modification, fine-tuning, and being aware of and controlling for factors which might confuse interpretation of the results.

As our example shows, the PBT can be used to look at trends over time in child mortality in one place (a hospital, a health clinic, a city, a district, a country). For the observed trends to be true indicators of changes in childhood mortality, it is important that there is no change in the any of factors which can affectthe observed levels of survival (i.e., P and Q) except the factor of mortality itself. We shall examine these "confounding" factors below.

It is also possible to use the PBT to make comparisons of childhood mortality levels for different places. This is more complex since it is harder to know that the confounding factors are not operating differently in the different places. Also, it may be harder to assess which of the conventional mortality measures described above in Chapter 2 is being estimated by the results of the PBT; this question, which has been studied in some detail, is discussed below.

B. The original approach (At-birth PBT)

The original development of the preceding birth technique was done by Brass and Macrae (Macrae, 1979; Brass and Macrae, 1984). The procedure was based on data on survival of preceding births collected at or very near to the time women gave birth to their next child. Subsequent theoretical development led to the possibility of data being collected during antenatal exams before birth or at the time of immunizations after birth (Hill and Aguirre, 1990). In this section we explore the original approach of data collection at or near the time of birth; in following sections we look at the two variations.

1. The logic behind the original PBT procedure

We have already described the basic logic which underlies the PBT: the proportion of preceding children dead is a measure of childhood mortality. However, to be useful for trend analysis and comparison purposes, the following requirements should be met:

a) We would like to be able to express data on proportions dead from this technique in terms of conventional measures of child mortality if possible;

b) the ways in which various extraneous factors affect the data must be understood and, if possible, controlled; and

c) the data must relate to a definable point in time.

We will deal with each of these requirements in the following discussion.

a. The relation of PBT results to conventional measures of child mortality

-[graph of real DHS interval data?]

[simulation/ sensitivity exercises with changing birth interval lengths71

Length of the birth interval A crucial factor in trying to relate PBT results to conventional measures of child mortality [such as q(2y)] is the length of the birth interval between the preceding birth and the index birth (the birth when the mother gives information about her preceding birth). If all birth intervals were the same length, I, then we could say that P, the proportion of preceding births which had died before the next birth, was equal to q(I), the probabilii of dying from birth to exact age I. Of course, all birth intervals are not the same, but can't we still say that P is equal to q(I), where I is equal to the average birth interval?

The. answer to this question is "no." The reason the answer is "no" is rather complicated. Perhaps the best explanation in words is found in the paper by Hill and Macrae (1985:7) (we attempt to provide a simple mathematical explanation in Appendix A):

...preceding births are clustered around a point in time roughly equivalent to the length of the mean birth interval before the current birth. This distribution is not symmetrical, since no births occurred within nine months of the current birth and...there is a very long 'tail' on the birth distribution before the mean birth interval. In addition, the age-specific mortality rates around age two are then beginning to change less rapidly with age.._ This means that all the children have been exposed to the very heavy mortality in the first year of life. Only a few of the preceding births have been exposed to the relatively light mortality prevailing from age two onwards. The net effect of the birth distribution...and the shape of the early age mortality curve...operating together is that the mean duration of exposure of preceding children will be shorter than the mean birth interval, (I)...

If the value for P is not equal to q(I) but equal to q(x) where x is less than I, can we assign a value for x? The answer is, fortunately, yes. Once again quoting Hill and Macrae (1985:7):

The convenient result which emerges from [the Brass and Macrae, 1984] calculations is that for many populations with high fertility and modest levels of contraceptive use, the period of exposure was 0.8 times the length of the mean birth interval. Therefore the proportion of preceding children dead at the time of the current birth is equal to the probability of dying between birth and an age approximately 0.8 times the length of the mean birth interval.

The multiplier of I is referred to as Y', defined as the factor by which the mean birth interval is multiplied to get the value for x. The value for Y' is usually set at 0.8, although some researchers have suggested that it may be closer to 0.9 in African countries (Li, 1990:12).

Effect of the length of the birth interval Our discussion so far has avoided the question of what are actual birth interval lengths. A major advantage of using the PBT is that it can be applied when very little data are available; data on birth intervals are often not available, so doesn't this make the approach useless?

The answer is "no" for several reasons. The first is that, according to some researchers, "[a]n average figure for this interval in high fertility countries and little use of contraception is about thirty months. In fact, even with some modest use of contraception, the mean birth interval for women in the central ages of the reproductive age span is also not far from thirty months" (Hill and Macrae, 1985:6). "...in most of the countries in which applications of the preceding-birth technique are likely, the intervals will not, in fact, vary a great deal from the central figure of 30 months..." (Hill and Aguirre, 1990: 323).

It follows. that in the absence of information to the contrary, we could take the mean birth interval as 30 months. Then with Y' equal to 0.8, the proportion dead would be equal to q(24m), i.e., the probability of dying within two years (24 months) of birth.

The second reason why interval data are not absolutely necessary is that even if the actual interval varies to some extent from 30 months, P will not be far from the value for q(24m); that is, the procedure is relatively insensitive to errors in the assumption that the average birth interval is 30 months (Hill and Macrae, 1985:7; Hill and Aguirre, 1990:323-324; Bairagi et. al, 1995:11). "[T]he high mortality risks of the earliest part of life have been experienced by all. The varying intervals are then over a range where the rates of change in proportion dead are small compared with the level. Consequently the effects of different distributions of the birth intervals on the survivorship of the children will be modest" (Brass and Macrae, 1984: 6).

[Do we want to do a simulation here?]

In the absence of data of some sort on the actual length of the average birth interval, then, we may usually make the assumption that I equals 30 months and that the proportions dead from the PBT calculations provide us with an estimate of q(24m).

What if the birth interval is not 30 months? We do have indications that if the birth interval varies substantially from 30 months, the proportions dead will still estimate q(x) and x may still equal 0.81 but will not equal 24 months. For example, in Matlab in Bangladesh, birth intervals were observed to be considerably longer than 30 months. Hence, P was closer to q(3 years) than q(2y) (Bairagi et al., 1995).

A survey of World Fertility Survey data for 25 countries found numerous instances where the average birth intervals were higher than 30 months (Li, 1990). Other studies have found intervals longer than 30 months as well (Prybylski et al.,1 992; Bicego et al., 1989).

We conclude that if birth intervals are substantially greater than 30 months and if the length of the intervals is known, the PBT can still give good results, using the formula P = q(0.8 x I).

What if the birth interval is changing? "As a larger percent of children survive [due to the intervention of child survival programs], birth intervals would become longer on average, causing problems for calculation of mortality trends" (Rutstein, 1989: 5). However, "...changes in the birth interval distribution could hardly have introduced appreciable distortions in the comparisons over years [in the Solomonsl. Any such effects are clearly negligible in relation to the substantial mortality falls shown" (Brass and Macrae, 1984: 7). In their study of Matlab data, Bairagi et al. (1995) concluded that "[t]he PBT was able to detect the differences in childhood mortaliiy in the two areas with different and changing birth intervals" (Bairagi et al., 1995: 19).

Use of PBT results without reference to conventional measures of childhood mortality There will be times when we are without any indication at all as to the length of the birth interval and when we prefer not to assume that the average birth interval is 30 months. Such a situation does not render the PBT useless.

Many factors affect the figures obtained by use of the PBT: the length of the birth interval is only one such factor (we deal with several others in the next section). Regardless of these factors, however, at a point in time the PBT results give an indication of the level of child mortality for a certain population. If there are no changes in the factors over a period of time, then the PBT will give an accurate indication of the change in child mortality over the period.

"...the preceding-birth technique was developed principally to measure relative changes in early child mortality rather than absolute levels. Hence it may be preferable to regard the proportion of previous children who have died as an index of early child mortality, rather than seeking an exact equivalent in a life table [i.e., a q(x) value]" (Hill and Aguirre, 1990: 324; emphasis added). "[T]he principal value of the results would be to provide a month-by-month (where numbers permit) plot of the index of early childhood mortality" (ibid.:330).

That is to say, one of the principal uses of the PBT is to provide small-area estimates of the trend (as contrasted with the level) of child mortality, probably with the goal of providing an indication of the effects of certain interventions. To do this, we do not need to be able to express the results in terms of a conventional measure; it is enough to have a measure which is calculated in the same way from period to period and which is not affected in changes by factors other than child mortality levels. Therefore, it has been suggested that PBT results be phrased in terms of an index of early childhood mortality: IECM. This IECM would be specific for a given place over a specified period, and it would serve the basic purposes for which the PBT was developed.

We now turn to a discussion of factors which may affect the validity of interpreting P as q(x) or even as an IECM.

b. What factors affect the PBT results and our understanding of them?

In its simplest form the PBT is designed to provide an indication of whether levels of child mortality have changed over a given period of time. For it to do this satisfactorily, we must know what factors can affect the results and how these factors operate. Furthermore, we must know if the factors have changed during the period of observation; if they have changed, then not only have they imparted some bias to the figures but that bias has changed. We have already discussed the effect of the length of the birth interval; we now turn to other factors of imponance.

1) Selection

The principal factor responsible for problems in interpretation of PBT results is selection. Selection refers to the fact that the women giving birth (or, in a variation, registering a birth) who answer PBT questions about the survival of a preceding birth are not all women and are not even representative of all women who are giving birth in that time period. This means that, regardless of whether the PBT results are expressed as a q(x) value or as an IECM, they cannot be interpreted as representing the mortality experience of all children born in the area. Furthermore, if selection changes over time, the results cannot even be said to apply to an unchanging, even if unrepresentative, group of women and their children. Even more troublesome would be comparisons among populations with different patterns of selection.

[Is this a quote?] The PBT is usually applied in a hospital or clinic setting, and it is well known that women who have access to and give birth in such settings are not representative of the broad population of women giving birth. They may be younger, better educated, more urban; they may live closer to the hospital or clinic, and be wealthier. On the other hand, they may have come to the clinic because they are having problem pregnancies or have had trouble in the past. Regardless, their presence in the study and the absence of other, different, women means that the results are biased.

What are the common characteristics involved in selection? There are a number of ways in which women who give birth in a clinic or hospital may differ from women who do not. We list here some of the most important ones, and the direction of the bias such selection would impart to the IECM.

Age Older women with higher parities are less likely to deliver in a clinic or hospital (David and Hill, 1992: 7). "[T]he risks of dying in childhood rise steeply with parity and mother's age" (Hill and Aguirre, 1990: 324). Insofar as younger women with lower panties are likely to have children with lower mortality, the selection of younger women works to lower the IECM.

Education In Bamako, it seemed "that better-educated young women are over-represented among clinic attenders" (Hill and Aguirre, 1990: 330). In general, education is negatively related to childhood mortality. Thus, selection for higher levels of education would impart a downward bias to the IECM.

Income and class "[T]hose likely [to give birth in a medical setting] are likely to be upper and upper middle class women from a major urban area...at a relatively low risk of mortality. On the other hand...poorer women with problem pregnancies are likely to seek medical assistance" (Rutstein, 1989: 3). "[S]election is likely to work in favor of the low-risk children of better-off mothers who live close to a health facility. The level of mortality in the population is thus likely to be underestimated unless a high proportion of births occur in health facilities (Hill, K., 1991: 372).

There is no clear answer to the question of the direction of bias imparted by selection for income and class, since the selection itself may be for higher or lower income and class. However, if we know the direction of the selection (e.g., toward higher class), then we know the direction of the bias (e.g., toward a lower IECM).

Urban residence Women living in urban areas tend to be better-off, higher class, and better educated. Since these characteristics are negatively associated with childhood mortality, so too is urban residence.

Parity Older women with higher parities are less likely to deliver in a clinic or hospital (David and Hill, 1992: 7). This factor works in tandem with age: in general, the higher the parity, the higher the childhood mortality. "[T]he risks of dying in childhood rise steeply with parity and mother's age" (Hill and Aguirre, 7990: 324). Insofar as women with high parities are poorly represented in situations where PBT data are collected, then, the bias is toward a lower IECM.

History of difficult pregnancies "[P]oorer women with problem pregnancies are likely to seek medical assistance" (Rutstein, 1989: 3). "One could imagine quite different patterns, however, if the basis for selection were different, e.g., if only women with previous obstetric problems or difficulties with the current delivery came to clinics" (Hill and Aguirre, 1990: 330). If women with previous problems with pregnancies, or problems with the current one, are more likely (and able) to come to a clinic or hospital than women with routine pregnancies, then the IECM received an upward bias.

Nearness to clinic or hospital "[S]election is likely to work in favor of the low-risk children of better-off mothers who live close to a health facility. The level of mortality in the population is thus likely to be underestimated unless a high proportion of births occur in health facilities (Hill, K., 1991: 372). Nearness to a medical facility implies use of that facility and hence better medical supervision and care. These would be associated with a lower IECM.

-What 'can be done to combat the problems posed by selection? There are several answers to this question.

i) First, it may be possible at least. to gain an indication of the kind of selection which is occurring. To do this we need to have various kinds of data on the women giving answers to the PBT questions, e.g., age, parity, income, education, urban/rural residence, etc. We can then compare these women with all women (or a representative sample of all women), if such data exist. For example, suppose the women giving answers to the PBT questions have an average of six years of education. We compare this with information from other sources, e.g., a census, which shows that women in general (more properly, recent mothers) have an average of three years of education. We can see that our PBT mothers are relatively well-educated, and from this we can infer that the mortality of -their preceding children was probably lower than the average for all recently-born children (because many studies have shown that the level of mothers: education is negatively correlated with child mortality rates).

This procedure would give us, if not quantifiable figures for the broader population of mothers and their preceding births, at least an indication of the direction of the bias imparted by selection in our particular situation. There are, however, two problems with this approach. First, the other data sources may not exist: there may not be a census or representative survey to provide comparable data. Second, the collection of extra data on the mothers involves more work, more trouble, a bigger burden on clinic or hospital workers or whomever is collecting the data. It is also a bigger job to prepare the data for analysis. The beauty of the PBT is its simplicity and ease of application; any additions makes it less easy and more complicated.

ii) Secondly, it is possible to do "sensitivity tests," mathematical exercises which help -quantify the biases due to selection.

> Two main factors are important: the initial proportion of the whole population covered by the health services, and the magnitude of the mortality differentials between the covered and the uncovered parts of the population. (Bairagi, 1995: 17).

Such an approach, thus, would involve knowing 1) approximately what proportion of women are covered by the PBT data collection program, and 2) approximately how much higher mortality is among the uncovered portion of the population. This last, of course, is not known, but assumptions can be made to test the sensitivity of the PBT procedure to the fact that not all women are covered.

> Broadly, when 80% of women are covered and the uncovered women have childhood mortality 1.5 times as large as the covered, then the

under- estimation of the true rate will be around 10% (Bairagi, 1995: 15).

According to Hill and David (1994: 5), "[T]he biases are small even when coverage rates are as low as 60%".

[Do we want to do such tests of our own here, to make clearer or more thorough? E.g., look at Mali coverage using DHS (others too?); simulation/sensitivity exercises with children of uncovered mothers at twice or half the mortality of those covered; in this connection see Li's results (pp. 13-l 4, Table 12), which showed much higher mortality for PBs without assistance, i.e., those which the real PBT would not catch but which were caught by her simulation. David and Hill (1992:7-8) give results of a simulation I should look at more carefully, except that the graph is missing!]

iii) A third way to deal with selection is to have a representative group of women providing the PBT data. In the usual clinic or hospital setting, of course, this is not likely to be possible: the women come to the clinic or hospital, which has little or no control over who comes and who doesn't. However, there is a variation of the PBT technique which involves asking the questions as part of a representative sample survey. The calculations involved are somewhat different from those used for the basic approach, and we do not present them here. For a discussion of the survey approach, see David, Bisharat, and Hill, 1990. We should note here, however, an important objection to using the PBT in a survey: surveys provide an opportunity to apply more sophisticated approaches to estimating child mortality, in particular the Brass CEB/CS questions, so the use of PBT in a survey is not really needed (see Hill, K, 1990: 373). In addition, of course, the major advantage of the PBT, its use at the time of birth with essentially no additional effort or time needed, would be lost.

What if selection is changing over time? All of the problems which selection poses are, of course, made worse if the character of the selection changes over time. For example, if we have relatively more well-educated women reporting answers to PBT questions in a clinic in one year than five years earlier, how are we to know if an observed fall in the IECM was due to a real fall in childhood mortality or simply to the change in selection toward women who have children with lower mortality?

There is no final answer to this question. It is likely, however, that selection bias will not change quickly over time (Brass and Macrae, 1984: 7; Hill and Macrae, 1985: 1). While the proportion of wellteducated women in the sample might change substantially over a period of ten or twenty 'years, it would probably change only slightly in any short period of time. Thus, short-term changes in the IECM would not likely be heavily affected by changes in the character of selection. "Used in this way [plotting month-by-month results], many of the selection problems...will be much less important" (Hill and Aguirre, 1990: 330).

[Could do a simulation here too, with changing compositions of women and a steady or falling IECM.]

Considering the existence of selection problems, can we compare different populations using the PBT? It is possible, of course, to compare IECMs for different populations. However, if we do not know that the samples are representative, or if we do not know at least what the selection biases are likely to be, we do not recommend that too much weight be placed on comparisons of PBT results between populations. As we have noted several times, the primary purpose of the PBT is to allow quick and easy calculation of an index of childhood mortality in a single setting in order to allow us to see if childhood mortality has been changing, especially in the presence of an intervention program.

2) Absence of last children from sample

By its very nature the PBT cannot gather 'information on last births: they do not precede any further births. This poses a question: does the absence of last births from the sample mean the resulting IECM is biased?

If last births have different mortality than other births, then their absence from the sample will cause a bias. However, if last births are only a small proportion of all births, as is true in countries with high fertility, then any bias will be minimized.

It is generally observed that high parity children have higher than average mortality. Thus, in high fertility countries, last children would have higher'than 'average mortality and a PBT estimate would be biased downward. However, if the TFR for a country were 6.0, then last births would comprise only some 17 percent of all births. For a country with a TFR of 3.0 (not likely to be a candidate for the use of the PBT), last births would comprise one-third of all births, but being of relatively low birth order, these births might not have any substantial mortality differential with first and second births. In a country with rapidly falling fertility, the changing composition of births by parity might lead to a change in the bias imparted by the absence of the last child, but in general, "it seems unlikely that this will be a serious source of bias in populations of moderate to high fertility" (Brass and Macrae, 1984: 7). "The proportionate difference in the survival of children of parity n + 1 compared with children of parity n for n > 5 is, nonetheless, likely to be small" (Hill and Aguirre, 1990: 324).

[This could be the subject of a simulation.]

3) Absence of only children from sample

By its very nature the PBT cannot gather information on only births: they do not precede any further births. This poses a question: does the absence of only births (and the consequent under-reporting of first births) from the sample mean the resulting IECM is biased?

If only births have different mortality than other births, then their absence from the sample will cause a bias. However, if only births are only a small proportion of all births, as is true in countries with high fertility, then any bias will be minimized.

"In most developing countries...the proportion of women with one birth who proceed to the next-higher parity frequently exceeds 95 percent, so women who stop at one birth will be a tiny minority. Whilst child mortality among these exceptional women with only one child would perhaps be lower than among others (higher socio-economic status and reduce possibilities for cross-infection?), the overall effect on the proportions of all previously born children who have died before a subsequent birth can safely be ignored" (Hill and Aguirre, 1990: 324).

Note that the biases resulting from omitting women with only one birth and omitting all last births tend to cancel each other: omission of last births tends to bias the IECM downward, omission of only births tends to bias the IECM upward (Hill and Aguirre, 1995: 324).

&4) Changing mortality levels

It might be expected that changes in mortality levels would confound the analysis of PBT results [but isn't tracking falling mortality exactly what PBT is supposed to do?]. Bairagi et al. (1995) examined this, using Matlab data that allowed both PBT simulations and direct calculation of mortality measures. They concluded that the PBT worked well in tracking falling mortality (p.14).

5) Changing mortality age patterns

Unequal changes in child mortality levels by age might be even more problematic for the PBT. Bairagi et al. found this to be the case: while levels and trends in proportions dead were quite similar to life-table values for q(36m), they could not be used to extrapolate to other indices (e.g., q(1y)).

Conclusion

The most important problems facing use of the PBT have to do with selection. Another ever-present problem, of course, is data quality and reporting errors, but this is not unique to the PBT and we do not deal explicitly with them in this section. "[Mlost of the potential problems, apart from incomplete coverage of all women who give birth and the possibility of reporting errors, are not very important... [I]n many instances ... adjustments . . . may be unnecessary" (Hill and Aguirre, 1990: 336-337).

c. Time location of estimate

One of the important features of the PBT is that it provides up-to-date information on child mortality for the recent past. But when exactly is the "recent past"? Here is how it is calculated.

Suppose for all preceding children who died, the interval between their birth and the subsequent birth was 30 months [which would be shorter than the birth interval for all preceding births, because of likely shorter periods of breast-feeding and, for very early deaths, shorter post-partum infecundabifiiyl. Suppose further that the average age at death for these children was nine months. Then the average date at the death of these children was 30-9 or 21 months before the date of data collection. (These figures are for Matlab and are taken from Bairagi et al., 1995.)

```
Preceding                    Index
 birth    Death              birth
 |--------+------------------|
 0        9                  30
 |<--9--> |<------21.........|
```

We may not have good figures on the birth interval of those who died or on the average age at death of the children who died: such information, if it could be obtained at all, might require an additional data collection effort, thus compromising the simplicity of the PBT approach. If, however, the information is collected routinely anyway, then this approach can be used.

In the absence of precise data on interval and age at death, an approximate figure of two-thirds of the estimated birth interval for all births can be used (David and Hill, 1992: 12).
"From models, Aguirre [1990] suggested that the PBT estimate of childhood mortality was located about two-thirds of the birth interval before the date of birth of the last born child..." (Bairagi et al., 1995: 9-10).

2. Administration and data collection

A major advantage of the PBT is that it can provide new timely information on child mortality without the imposition of substantial new amounts of work and data collection efforts for -health workers. "The only additional -work will involve systematizing the format of the questions put to mothers...; making plans for the collection of the. raw data;. and training health workers to use the data effectively" (Hill and David, 1994:15) "The main practical problem is the routine capture and analysis of the basic information on the survival of the preceding born, whether originally recorded on home-based records or in clinic records" (Hill and David, 1994: 11).

The required data can be collected by asking one or at most a few additional questions of new mothers (or mothers registering their recent births). In this section we deal with the mechanics of data collection; in the next we turn to the details of using the data to calculate an IECM and related measures.

a. Time of data collection

Correct application of the PBT requires that data be collected "at or very soon after the most recent maternity [the index birth]" (Hill and Macrae, 1985: 8). In practice this will mean data should be collected at the time a birth takes place in a clinic or hospital. However, depending on the circumstances, data may also be collected when the index birth is registered if registration occurs very soon after the birth. In fact, this is what was done in the first application of the method in the Solomons (Macrae, 1979; Brass and Macrae, 1984).

"Village health workers may also be able to do an excellent job of reporting on the survival of preceding births, even when the subsequent delivery occurs at home: (Hill and Aguirre: 1990: 337)..

b. Questions

The basic information needed can be obtained from the following single question: "Is your last-born child still alive?'" (Brass and Macrae, 1984: 6). This question, however, really asks more than one thing at a time, and a better approach would be a slightly longer but more precise sequence such as the following (Hill and Aguirre, 1990: 337; Hill and David, 1,994: 17):

Have you been pregnant before?
(^Yes/No)

If yes, what was the outcome of this pregnancy?
(Live birth, still birth, miscarriage)

If a live birth, is this child still alive today?

(^ Yes/No)

c. Forms and procedures

It is possible that the needed information is already being collected. "In many places, the survival of the preceding child is already being collected in delivery room books or on cards held by mothers... On most versions of the cards, the number of previous pregnancies and the neo-natal survival of the preceding born child are already being collected" (Hill and David; 1994: 10). If the information is not already being collected, the questions may easily be added to whatever data collection system is already in place. "The preferred strategy seems to be to integrate the PBT questions into existing reporting systems... Tanzania is one country in which this is already underway" (Hill and David, 1994: 9).

The actual format for PBT data collection will vary and will of course depend greatly on the procedures already in place for collection of other data; it is "impossible to generate general advice for all situations" (Hill and David, 1994: 9). We mention here a few of the alternative systems which have been used.

Mother-held card "The mother-held record card contains information of ante- and post-natal care and details of the interval following up to 4 births to the same mother.. . Data can be entered on to the card by health workers, TBAs and the mother herself.... The basic card has been adapted for use in 13 centers in 8 countries.. . In some places, data are extracted from the cards and recorded in clinic registers" (Hill and David, 1994: 9-l 0). [A copy of the Zimbabwe home-based maternal record is found as Appendix 3 of Hill and David, 1994: 21-24.1

Self-carbonizing copies In Papua New Guinea, "[e]ach registration form had a unique number and a self-carbonizing copy that was sent to the Provincial Health office. The original copy was offered to the mother. She received it free if she had a supervised delivery either in a health facility or by a village midwife, but was required to pay a small fee for it if she had given birth unsupervised in the village. The certificate was designed to look official and be attractive to the mother" (Prybylski et al.: 529).

Tally sheets In Bamako (Hill and Macrae, 1985) and Haiti (Bicego et al., 1989), tally sheets were used for listing individual women and their children. information on the tally sheets included for the mother: her identifying number, age, children ever born, number of children surviving, literacy; for the index birth: sex, weight, place of delivery, and if live or stillborn; for the preceding birth (and, in Bamako, the preceding birth but one): survival status, sex, date of birth, and age at weaning. These sheets thus collect much more information than is needed for the basic PBT estimates and could be modified in many ways (e.g., cause of death, age at death, etc...see Hill and David, 1994: 17), so long as the basic information is included. [A copy of the Bamako form is found in Hill and Macrae, 1985: 14; Bicego et al. say there is a copy of their form in the Appendix, which I don't have.1

Duplicate clinic-held records Simple copying may be done from clinic form to another form. If a clinic or hospital keeps a standard record book, answers to the PBT questions can be incorporated in that. To obtain PBT estimates, "[s]ummary counts of the children alive will then need to be made at regular intervals" (Hill and David, 1'994: 16).

We may note here that "[f]or measurement of childhood mortality alone, individual mothers need not be identified separately and an aggregate count of the previous children born alive and surviving will suffice" (Hill and David, 1994: 16). This approach, while providing the basic PBT estimates of child mortality, would forgo other benefits.

Sample 'card weeks' as in Oman [?]

Hand-held computers "There are now several reviews of the results of ... trials in Latin America as well as an advanced package which, among other things, controls the data entry and converts the proportions dead to other life table measures of childhood mortality" (Hill and David, 1994: 6-7).

d. Additional work involved

It is clear that, however simple a new method, it cannot be put into operation without additional effort on someone's part. In the case of the PBT, the additional effort is rather small, but still must be made. Furthermore, there may be resistance to any change and increase in workload on the part of health workers (e.g., midwives complained some about additional work in Bamako [Hill and Aguirre, 1990: 326). Careful explanation of the method and its benefits is necessary to minimize such resistance. It is anticipated that we will develop a companion manual to this one designed for application of the PBT by health workers in different circumstances (see Hill and David, 1994: 25, for a tentative outline of this manual).

e. Other considerations

Mothers' reactions The PBT questions are somewhat sensitive, dealing as they do with previous children who may have died. It is thus important that the possible reactions of the respondents to the questions be anticipated and taken into account in the design of the questions and decisions aboutwhen and how to ask them.

Size of sample "Reliable estimates of the proportions of preceding children who have died can be derived from samples of the order of 1000 mothers since the standard errors will be those of a simple proportion close to 0.2 in many cases... [The PBT could thus1 be used to produce annual childhood mortality estimates for populations as small as 20,000 and monthly mortality indices for populations of about 250,000 (assuming a crude birth rate of 50 per 1000)" (Hill and Aguirre, 1990: 337).

Twins and triplets If the preceding "birth" was actually multiple, the question on survival should be asked of each member of the multiple birth. Each preceding birth, whether multiple or not, is treated by the PBT as a separate case for purposes of estimating child mortality.

3. Strengths and advantages of the PBT

There are a number of features of the PBT which make it an attractive choice for the estimation of child mortality.
We have discussed some of these above; we include them below for the sake of completeness.

a. Costs

The costs of producing PBT estimates of child mortality are low. One observer stated that "data collection and analysis costs are trivial..." (Hill, K., 1991: 372). Costs may be divided into 1) the costs of preparing for data collection, basically questionnaire design and staff training, which can be fairly brief; 2) the costs of the data collection itself, marginal if any other records are being kept; 3) the costs of preparation of data for analysis, which are not great because the amount of data is not great; 4) analysis costs, which are quite small because only one measure, the IECM, is being produced, although if estimates are prepared for different subgroups, more time and cost may be involved; and 5) costs of the dissemination of 'the results-preparation of reports. None of these need involve a major expenditure of funds.

b. Time and work

Once the PBT system is in place, collecting the data requires only a very little additional work, since some data collection efforts were already in place. Asking two or three questions takes very little time. There will be additional time and effort required for data preparation, analysis, and dissemination, of course, and while these may not be trivial, they should be balanced against the gains from the method. "[I]t is worthwhile stressing the gains to be obtained from collecting data on a routine basis as part of the health information system....accuracy and completeness of the answers provided by mothers... In addition, extra variables can be readily obtained, such as the valuable information on birth weights" (Hill and Aguirre, 1990: 330).

c. Local-level emphasis

"The PBT is best suited for local or district levels" (WHO, 1994: 708). This is both an advantage and a disadvantage. It is an advantage because there are few if any other procedures which can produce estimates of child mortality at the local level, especially if these estimates are needed quickly. On the other hand, because of the varying effects of selection and other factors, PBT estimates for larger areas would be much more problematic; national and sub-national estimates of child mortality would be better prepared with use of the Brass CEB/CS approach.

Apart from the local-level focus of the actual PBT estimates, the approach offers other local-level rewards as well. For example, the staff can be deeply involved in all phases of the data collection and production of results (Hill and David, 1994: 14). Such involvement cannot help but build a sense of responsibility and an interest and dedication to the PBT approach and to the whole health system of which it is a part.

Additionally, the fact that estimates' are produced locally by local staff means that a capacity for self-evaluation is created or strengthened. Given the emphasis on local areas in recent health initiatives, this is a factor of major importance.

d. Analysis and interpretation

Trends, not levels The PBT's "strength is its ability to detect relative changes, rather than as a very secure method for measuring absolute levels of mortality" (Hill and Aguirre, 1990: 337). We have talked above about the fact that the PBT was designed to produce an IECM to measure small-area trends; its ability to provide estimates of mortality levels expressed in terms of conventional measures is much more limited. Of course, when the conditions are right for estimating such conventional measures, the power of the method is that much greater.

Recent reference period The estimates produced by the PBT, as discussed above, generally refer to a period of two years or less before the date of data collection. No other estimation procedure produces reliable estimates of such recency, and even complete registration systems are hard put to produce their figures in a timely fashion.

Short-term changes are detected With repeated or continuous application, the PBT can detect short-term changes in child mortality (Hill and Aguirre, 1984: 7).

Simplicity The PBT is simple to apply, simple to analyze, and simple to understand. Analysis can be restricted simply to looking at the proportions dead among preceding births, i.e., the IECM. More complicated analysis can certainly be undertaken, given the availability of more data, but the basic product is the result of counting preceding births, deaths to them, and dividing the latter by the former. In contrast to other estimationmethods, e.g., the Brass CEB/CS approach, there is no dependence on other data sources or model life'tables (Brass and Macrae, 1984: 7). This feature makes it possible for estimates to be prepared in a timely fashion by clinic or hospital staff without resort to complicated methods or involved calculations.

Best index of early childhood mortality Whether or not the IECM is equated precisely with a more conventional measure of mortality such as q(2y), the period of childhood covered by the IECM will always be somewhere around two years. For several reasons a measure of probabilii of death before age two is a better measure of early child mortality than is the Infant Mortality Rate (IMR).

"...for many purposes the proportions of children surviving or dying by age two will be a better index [than the IMR]. Several African studies have show how numerous are the deaths between ages one and two... In addition, some evidence suggests that some African mortality patterns may be quite distinct and different from those incorporated in standard model life tables... and in these circumstances, q(2) will be a more robust measure of early childhood mortality than q(1)" (Hill and Macrae, 1985: 7).

The period to which the IECM refers covers hazards and events that are simply not present in the first year. "The effects of changing patterns of breast-feeding and nutritional supplementation during the weaning period, often extending into the second year of life and even later, will be more fully encompassed by observing changes in the IECM" (Bicego et al.,, 1989: S21). The IECM is "...often a better index than IMR of the impact of health interventions since these interventions [such as vaccination programs] often affect particularly survival of children over age one..." (David, Bisharat, and Hill, 1990:24)

Finally, "[t]he IECM should be less sensitive than the IMR...to the commonly observed under-reporting of early neonatal deaths" (Bicego et al., 1989: S21).

e. Related benefits

"There are many additional benefits to both mothers and children from collecting the data. in this way" (Hill and David, 1994: 15). These include (Hill and David, 1994: 18-1 9):

Identifying problem areas where a special focus is needed.

Understanding distribution of risk or differential risks among the population.

Family risk assessment to improve/set targeting strategies to reach high risk groups.

Patient management and follow-up of high-risk mothers.

Case investigation of adverse outcomes - were these missed opportunities?

Cause of death inquires might be possible if data are obtained by health clinic staff.

Evaluation of services, as noted above, can be done by clinic staff. Health information system reform may be accelerated by involving health workers more in the use and application of the data.

Support for increased resources from public expenditures can be provided by timely and accurate information on child mortality and its responses to interventions.

Local awareness can be increased by provision of information on clinic and local mortality rates.

4. Calculations, interpretation, and analysis

Basic calculation As we have already noted, "[t]he basic calculation of the index of early childhood mortality ... from the total number of previous born children alive and dead is trivial" (Hill and Aguirre, 1990: 327). Once the data are collected on the number of preceding births and the number of deaths to those births, a simple division produces the basic result, the index of childhood mortality (IECM).

Basic result: an IECM We have discussed above the fact that the PBT was designed principally to produce information on child mortality trends for small areas. "Since the emphasis is on changes in child mortality, the method may still give valuable results in circumstances where the coverage of the maternity services, although incomplete, is not changing rapidly in the short-run" (Hill and Aguirre, 1990: 320); "...the preceding-birth technique was developed principally to measure relative changes in early child mortality rather than absolute levels. Hence it may be preferable to regard the proportion of previous children who have died as an index of early child mortality [IECM], rather than seeking an exact equivalent in a life table" (Hill and Aguirre, 1990: 324).

"[T]he principal value of the results would be to provide a month-by-month (where numbers permit) plot of the index of early childhood mortality. Used in this way, many of the selection problems.. will be much less important" (HA, 330).

Estimating q(x) Problems of selection aside, the IECM will generally give an estimate of q(x), where x equals two years or, more properly, a (=0.8I). When the interval I is equal to approximately 30 months, then the IECM will be approximately equal to q(2y) for the population involved. (As noted above, when I is not known and cannot be reasonably estimated, making the leap to a value for x may not be easy or justified; Li, 1990, points out (p. 16) that it is unlikely that I would be readily available in most countries where PBT would most likely be carried out. Thus, using P to estimate q(o.8I) would be impossible without making an assumption as to the length of I.)

[Here we might put a graph similar to that on the first page of Hill and Aguirre, of q(2y) versus proportions dead, to see how closely the PBT results track q(2y) even when the assumptions are not strictly met.1

Extrapolation to other measures It is possible to extrapolate from the IECM to estimate other measures of child mortality, e.g., q(l y) (essentially the same as the IMR) and q(5y), the Under 5 Mortality Rate. However, such extrapolation involves assuming that the shape of the mortality curve for ages under five is known or is matched by the curve of a model life table. Such an assumption is not always justified and, when badly off, can produce.estimates of mortality measures that are substantially in error.

This is not to say that such extrapolation has not been tried. In Papua New Guinea, researchers had information on age patterns of child mortality from a continuing demographic surveillance system. "Values of q(l), the risk of dying by the age of 1 year, were estimated from observed q(2) values using Coale-Demeny model West standard life tables on the basis of observed age patterns of child mortality in the Tari Research Unit surveillance area" (Prybylski et al., 1992: 530).

Interpretation Estimates produced by the PBT are usually seen as a minimum (Hill and Aguirre, 1990: 330). For example, in Papua New Guinea:

The mortality rates derived from the [PBT] should be considered as minimum estimates for a number of reasons. Some remote, sparsely populated regions of the province still have no access to health care and the estimates of q(2) in these areas are undoubtedly much higher. Moreover, it is probable that a certain proportion of neonatal deaths among previous births were reported as stillbirths, in order to avoid the social stigma attached to the mother whose live-born infant has died. Mortality is especially high during the neonatal period and hence q(2) would be underestimated. Finally, a maternal-infant death, while rare, would resulting in under- reporting but this might not change q(2) (Prybylski et al., 1992: 534).

What population is represented? Apart from problems of selection, there is another problem with regard to the population represented by the results of the PBT. Li points out (1990: 11) that preceding births could have been born up to 20 years earlier. Even though we can make a time location of the estimate (see above), the births contributing to the estimate occurred over a time span of many years. During that time span there were other births occurring (not included in the PBT calculations for various reasons, including not being preceding births); the mortality experience of these births is not included in the estimate. The PBT necessarily deals in averages, which to some extent makes the seeming precision of its estimate a little misplaced.

5. Disadvantages and limitations

While the PBT has a number of advantages over other methods, there are also'drawbacks and limitations to its use. We list below the most important of these, some of which have already been discussed.

Trends As noted above, a single application of the PBT cannot provide information on mortality trends, as can the Brass CEB/CS and maternity history approaches. However, repeated applications of the PBT can give information on trends, and in fact this'is the way it is most usefully applied. A single application of the PBT will provide an IECM, but that IECM may or may not be justifiably translated into a conventional measure of the level of child mortality. On the other hand, repeated applications of the PBT will provide valid information on the trend in child mortality regardless of whether the IECM can be translated into more conventional measures or not. Thus, in almost any setting, the PBT can provide information on recent trends in child mortality.

Age pattern of mortality The PBT provides no information on the age pattern of mortality. The single piece of information it provides, the IECM, gives the probability of dying before a certain age (depending on the birth interval). There is no sure way to know what the probability of dying before younger or older ages is. Inferences to other ages can be made, but they must be made on the basis of an assumed age pattern of mortality, e.g., a model life table.

Cause of death The PBT provides no information on cause of death, but rather provides information on the probability of dying from all causes before a certain age. Additional questions and "verbal autopsies" may provide information on cause of death, but these make the administration and interpretation of the measure more difficult. As we have noted before, much of the beauty and usefulness of the PBT lie in its extreme simplicity of data collection and calculations.

Confounding factors As discussed above, a number of factors other than the level of childhood mortality can affect the proportions dead and the subsequent interpretation of the IECM. Chief among these is selection: there may be no way of knowing the mortality differences between the covered and the non-covered population. Even more troublesome, the kind and amount of selection occurring may change from one application of the PBT to the next, so even comparing successive IECMs may be problematic. However, sensitivity analysis [did we do it?] suggests that selection can be taken into account to a degree and that in the short run changes in selection are not likely to affect the overall estimation of mortality trends.

The length of the birth interval is another factor affecting interpretation of the IECM. If birth intervals vary substantially from 30 months, then the IECM will not be a good estimate of q(2y). However, as we have discussed, the translation of the IECM to a life-table measure is not necessary for achieving the basic purpose of the PBT. And, as with selection, in the short run changes in birth intervals from one application of the PBT to the next are not likely to materially affect the results and interpretation.

Other factors, already discussed, include the fact that last children and only children are not covered (these somewhat compensate for each other) and the fact that mortality levels may be changing (which the PBT can deal with).

6. Validating PBT results

So far we have talked a lot about the theory of the PBT and why the procedure should produce valid and useable results, but we have presented little [actually, nothing1 in the way of empirical validation. In this section we present results of several studies which have compared the results from the PBT with results from other approaches.

The basic way such comparisons are done is as follows. If we have a data set which allows application of several different estimation procedures, we can apply them all and examine how they compare. A closely related approach is to use one data set, such as that from a continuing demographic surveillance program, to produce estimates of childhood mortality using Brass or life- table approaches; an independent. application of the PBT produces mortality estimates for a point in time covered by the other approach_ In -particular, tests of the PBT have looked at its results compared to results from application of the Brass CEB/CS approach and to life tables calculated using maternity histories. It would also be possible to compare PBT results with figures from vital registration systems, if good quality systems existed for the same geographic region as the PBT.

a. Rutstein (1989) looked at data from the Demographic and Health Surveys (DHS) for six countries. DHS surveys are national sample surveys, and hence do not collect data in the way supposed by the PBT, i.e., in clinics or hospitals. However, PBT results could be approximated by looking at women who had received medically- trained assistance at birth.

Rutstein was concerned with conventional mortality measures, basically q(1 y), q(2y), and q(5y). These were calculated first by using a "standard DHS and World Fertility Survey procedure," then by using several variations of the PBT. Since the PBT does not produce figures for q(l y) or q(5y) even if the IECM is acceptable as a proxy for q(2y), model life tables had to be used to convert the IECM-q(2y) figures to the other measures. As we have noted, this is stretching the purposes and abilities of the PBT rather far beyond the original purpose.

Rutstein concluded that the PBT estimates did not satisfactorily correspond to the life-table values, and blamed this on selection, birth interval problems, and omission of last and only children. We might comment here that he was probably asking more of the PBT than should be asked in most situations.

b. Li (1990) examined World Fertility Survey (WFS) data for 25 countries. She used three pieces of information to simulate application of the PBT: the birth-date of the most recent child, the birth-date of the next-to-most recent child (the preceding birth), and the survival status of the preceding birth. PBT results were compared with life-table figures calculated from the same data.

One set of Li's findings refers to whether the IECM (, or proportions dead) indicates differential mortality in expected directions. Testing age of mother, urban/rural residence, education of mother, medical assistance at birth, birth order, and sex, she found that the IECM produced mortality estimates with the expected differentials.

Li also found "the correspondence between the proportion dead and q(0.8l) to be quite robust" (p. 11). However, because the birth intervals for her countries "were closer to 36 months than 30 months," overestimated q(24m). That is to say, because intervals were longer than 30 months, x of q(x) was greater than 24 months. Interval length was affecting the age to which the IECM corresponds but it was not affecting the fact that the PBT was faithfully reflecting mortality levels. When Li limited the births in the sample to only those born 3, 4, or 5 years before the last birth, thus effectively lowering the average birth interval to close to 30 months, she found that "[o]n average, the proportions dead corresponded to life table ages slightly higher than 24 months" (p. 12). Li also found evidence that Y' might be closer to 0.9 than 0.8 for African countries.

Li grades the method by how closely P comes to q(24m). This misses the point that the PBT is best viewed as a producer of an IECM, i.e., it stands alone for purposes of estimating trends for particular places and need not necessarily be closely tied to a particular conventional measure such as q(24m).

c. Hill and Aguirre (1990) prepared a graph (p. 317) showing, for nine WFS countries, PBT data on proportions dying and life- table calculations of q(2y). They found that there was remarkably good agreement between the two figures for the various populations.

[If we don't do our own, it would be nice to reproduce the Hill- Aguirre graph here.]

d. Prybylski et al. (1992) compared PBT results with estimates from a continuous demographic surveillance system in Papua New Guinea. PBT data were obtained via a clinic-based birth registration system; 98 percent of all registrations were in the first month of life, so the approach closely approximated data collected at birth. Proportions dead calculated from the PBT and q(2y) values calculated from the surveillance system data were quite close. The researchers found that long (approximately 40 months) birth intervals did not seem to have had a major effect (the 40 month figure was for surviving births only, so the interval for all births including those that died would have been somewhat shorter).

e. Bairagi et al. (1995) looked at data from Matlab in Bangladesh. Data from the continuing surveillance system were used to calculate life-table values for probabilities of survival; these were compared with PBT values calculated using the same data.

Birth intervals in the study were high...close to 40 months. In contrast to the results from Papua New Guinea, in Matlab the effect of a long birth interval was to make values for proportion dead closer to q(3y) than to q(2y). Although several authors [refs above1 have argued that by age two cumulative mortality is not rising very rapidly and hence that q(2y) and q(3y) are not very different, in Bangladesh the "cumulative probabilities of dying . . . continue to rise steeply beyond age 2.., a feature not common elsewhere" (p. 11). Thus, the effect of a longer birth interval may be more pronounced in Bangladesh than in populations where mortality has leveled off by age two.

As noted- above, the Matlab study also showed that the PBT is able accurately to measure mortality differentials by area, mother's education, and sex of previous child.

f. Other studies

Hill and David (1989) for The Gambia report that tests of the PBT against life table data "confirm that the . . PBT method yields a recent estimate of early childhood mortality in line with life tables constructed from a birth history" (David, Bisharat, and Kawar, 1991: 315).

Hill, Aguirre, and del Aguila (1987) for Peru report that tests of the PBT against life table data "confirm that the . . PBT method yields a recent estimate of early childhood mortality in line with life tables constructed from a birth history" (David, Bisharat, and Kawar, 1991: 315).

David, Bisharat, and Kawar (1991) report on trials in Syria, Jordan, and Djibouti of surveys with PBT modules, yielding a PBT estimate as well as a life-table estimate. Problems in constructing the life-tables in both Jordan and Djibouti made the comparisons invalid; in Syria, "the survey Preceding Birth Technique estimate . . . agreed with. life table and CEB/CS estimates(p. 315). (Note that these three studies used surveys, not clinic or hospital registration, to collect the data.)

[Do we want to add to the series?: comparisons of PBT (at birth) results with vital registration, census, and survey data: do this using DHS and life tables or Brass; put on graph with PBT estimate, as have several studies and critiques.1

7. What can programs do with PBT information?

[AH: informing others/presentation: making the connection with other estimates of child mortality, using the numbers, routine reporting of index by clients, etc.1

What can be done with the results of the PBT once they are in hand? The same question can be asked, and many of the same answers would be given, about other procedures for producing estimates of child mortality. However, special features of the PBT make it especially useful in certain situations and for certain purposes.

o The basic and most immediate action to take once PBT estimates have been completed is to make them available to interested and authorized parties. Such people would include clinic and hospital administrators, health service officials, local and district government officials, researchers, etc. Who needs to know? Who wants to know?

The information should be presented in a simple and clear manner, with short explanations discussing what the data do and do not show and how limited the'interpretation should be. For example, when an IECM is the only figure presented, presumably for several points in time so a trend can be observed if there is on, the text should make clear that the IECM is specific to this one particular situation and cannot necessarily be compared with IECM from others places. If the situation justifies transforming the IECM into one or more conventional measures of mortality, then values for these measures for other places may be presented to put the local figures in context.

For repeated reports from the same project, it might be advisable to devises general format which could be used time after time, each time incorporating previous values and adding the new one(s) in an easily understandable series.

o "[I]nformation can be passed to higher levels to meet reporting requirements" (Hill and David, 1994: 18). An outstanding feature of the PBT is that such information can be made available almost immediately after the end of the data collection period (which will vary depending upon, among other things, how long it takes to achieve a sample of reasonable size, roughly 1,000 births).

"[I]nformation can be used at the point of collection to monitor, evaluate and reform services delivered at the district, regional or national levels" (Hill and David, 1994: 18). This is made possible by the fact that PBT results can be prepared at the point of collection by staff trained in the procedure-and the procedure itself is extremely simple.

o "Managers can use the data to identify problem areas where a special focus is needed. [For example, dloes the information reflect problems with service delivery?" (Hill and David, 1994: 18).

o "The information can be used to understand better the distribution of risk or differential risks among the population in the catchment area" (Hill and David, 1994: 18). PBT estimates of child mortality can be prepared for any group that can be identified and that has sufficient sample size. Thus, in Bangladesh, differential mortality was studied by area, mother's education, and sex of previous child. The opportunities here are limited only by the need and ability to collect data on characteristics of the mother and the preceding birth.

o "Family risk assessment to improve/set targeting strategies to reach high risk groups" (Hill and David, 1994: 18). High risk mothers can be identified as those whose previous child had died. High risk groups can be identified if the data support this, i.e., e.g., if data are collected on education or ethnic group or any other characteristic that might influence mortality. Once identified, these individuals and groups can be the subject of efforts to lower their childhood mortality. "Case investigation of adverse outcomes - were these missed opportunities? (e.g., was the mother immunized against tetanus before the birth. Was the. child immunized? Did the mother use the health services 'at any time during pregnancy or preceding the child's death?)" (Hill and David, 1994: 18).

o "Information on clinic and district mortality rates can be used to increase local awareness and involve district health committees and organizations in setting priorities for community health services" (Hill and David, 1994: 19).

o "Data can be used to advocate for increased resources from public expenditures and to provide information on reallocation needs" (Hill and David, 1994: 19).

CHAPTER 4: APPLICATIONS OF THE PRECEDING BIRTH TECHNIQUE WHEN MOTHERS ARE SEEN IN ANTE-NATAL CLINICS

The Preceding Birth Technique as originally developed was designed to use information obtained from women at or near the time of giving birth. It has since been modified to allow data gathering from women before giving birth and after having given birth. In this. section we discuss the application of the PBT in an ante-natal setting, while in the following section we deal with data collected after a birth.

1. Logic behind the ante-natal approach

a. Basic logic

Recall that the basic logic behind the original PBT is that proportions dead among previous births tend to approximate q(x), where x equals 0.8 . I. I is the interval between the previous birth and the succeeding birth, i.e., the interval between the preceding birth and the moment of data collection. Variations of the PBT are founded on the reasoning that it is valid to use intervals other than the inter-birth interval, e.g., I-3 months, which would be the average interval between birth and being seen in an ante-natal clinic.

The logic is made more persuasive by the fact that cumulative mortality levels are not rising very rapidly by the second birthday: the probability of dying by age 27 months is not that much different from the probabiliiy of dying by age 30 months.

"Reports on the proportions of previous children dead obtained from pregnant women will be indistinguishable [emphasis added1 from those obtained at the time of delivery since a reduction in the duration of the period of exposure of the previous child to the risks of dying by a month or two is unimportant. Mortality risks around the second birthday change only slightly within the space of a few months..." (Hill and Aguirre, 1990: 331).

"The under- or over-estimation of under 2 mortality resulting from collecting the data before or after a birth was very small and was in any case offset by the effects of some under-estimation of the true level of mortality by the omission of some high mortality women due to incomplete coverage" (Hill and David, 1994: 5).

"Surprisingly, the effect of collecting the PBT information before the birth on the mortality estimate is very small" (Hill and David, 1994: 15)

b. Calculations

Calculation of the ante-natal PBT measure is no different than for the original PBT: deaths are divided by births to give the measure of proportion dead. We discuss interpretation of the measure and problems involved with the ante-natal approach below, after discussing the collection of ante-natal data.

2. Administration and data collection

It is in the data collection rather than the data manipulation that the ante-natal approach differs most from the at-birth approach. Whereas the at-birth approach involves collecting data in a clinic or hospital (or, in a variation, when births are registered soon after), the ante-natal approach requires that women be seen and data collected from them sometime before birth. The whole approach was developed, of course, because ideally all women are seen in ante-natal clinics. Insofar as not all women are seen in the clinics, the approach suffers from selection problems. However, it may well be that a higher proportion of pregnant women visit ante-natal clinics than subsequently give birth in clinics or hospitals. Where this is true, a higher and possibly more representative proportion of the population is covered.

a. Data recording

A major question with this approach is where should the data be recorded? Options include the ante-natal clinic (ANC) records and a home-based record held by the mother. If the latter, there is the problem of "capturing" the information from the home-based cards...

b. Timing of data collection'

The ante-natal PBT is usually added on to the already- established system of information gathering based on the visits of pregnant women to an ANC for health services related to their pregnancy. Thus, the timing of the data collection is constrained by the practices already set up regarding when 'pregnant women visit the clinic. There is an additional variation from the at-birth PBT: pregnant women may visit the ANC more than once. If they do, a decision must be made as to the optimal time to collect the PBT data. Statistics need to be kept, -if possible, on the date of the data-collection visits (e.g., 7th month of pregnancy), so that there is some insight into the length of the interval between the preceding birth and the data collection.

3. Strengths and advantages

The PBT administered in an ANC has several major advantages over the original at-birth PBT.

a. Coverage

"[I]n developing countries, the proportion of mothers receiving ante-natal care or the proportion of children receiving at least one vaccination is much higher than the proportion of mothers delivering in a maternity clinic... Most of the criticism which has been levelled at the PBT has been in connection with the biases implicit in the results when coverage of mothers and children by the health services is incomplete" (Hill and David, 1994:4).

"[T]he effects of incomplete coverage of mothers is also slight, as the simulated data from Bangladesh show" (Hill and David, 1994: 15)

b. Associated data

A problem associated with the PBT at birth approach is that the collection of additional data may be difficult or awkward. Wiih the ante-natal approach this problem is minimized, since the ante-natal setting is already one in which much information is collected.

"[T]his is the preferred time to collect the data on the preceding child since it is at the ante-natal visits that the other information for the mother-held cards is filled in" (Hill and David, 1994: 7).

c. Risk intervention

Women whose preceding birth had died may be at greater risk of another early childhood death. A unique advantage of the ANC application of the PBT is that information is obtained on the mortality of the woman's preceding birth. Thus, women with past and hence potential problems may be identified and dealt with as appropriate.

"In addition, this is seen as the right moment to intervene with spacial care for the expectant mother if so indicated" (Hill and David, 1994: 7).

d. Ease of administration

The ANC application of the PBT is not necessarily all that much easier than the PBT at birth approach, but administration is easy. The simple addition of the basic questions to the data collection instrument already in use will provide the necessary data. Some care must be taken to avoid various problems (see below), but in general very little extra work or paper is generated when PBT questions are added to ante-natal data collection procedures.

4. Interpretation and analysis

a. IECM vs. q(x)

Apart from considerations similar to those regarding the at- birth PBT approach, there is only one major additional point to discuss regarding the theoretical interpretation of ante-natal PBT applications. This applies to -the issue of interpreting the results as an IECM or in terms of a conventional measure of mortality.

The former is certainly easier: all one must do is calculate the proportions dead and report them as an IECM. This approach is best used when restricted to one site and to the goal of tracking mortality change over time.

Expressing proportions dead in terms of a conventional measure of mortality [i.e., q(2y)] allows comparisons among different sites, both within one district and nation and across nations. Hill and Aguirre (1990) show that for the ante-natal case, "the mortality estimates obtained from the proportions of preceding children dead among women seen 3 months before delivery slightly underestimates q(2) but the difference is small..." (Bairagi et al., 1995: 4). Of course, all of the previously mentioned PBT problems are in force: varying degrees of selection and different intensity of other factors which affect the proportions dead.

b. Time location of estimate

Regardless of which if any conventional mortality measure the ante-natal PBT is estimating, there is still the question of the time location of the estimate. If we use the same logic as was used above to locate the at-birth PBT estimate, we get the following diagram, which refers to a situation when the ante-natal clinic records are collected approximately 3 months before birth.

```
Preceding                    Index
  birth     Death          ANC birth
  |---------+--------------|
  0         9          |  30
  |<--9-->|<------21------>|
  |<--9-->|<-----18----->|
```

In this situation, with an average birth interval of 30 months and an average age at death for preceding births of 9 -months, the time location of the PBT estimate is some 18 months prior to the ANC data collection. With shorter or longer intervals the time location would vary accordingly.

5. Limitations and disadvantages

There are a number of ways in which one must be careful in applying the PBT in an ante-natal setting, in addition to the limitations associated with the PBT no matter when it is applied. We list these briefly below.

a. Double counting. There is the danger of double-counting if clinic records are not organized around individual women. If data collection is done with use of a simple tally sheet listing, among other things, survival of preceding births, women might appear on tally sheets for different periods and thus have their experience included twice. There must be some way of making sure that each woman is represented only once in the data records.

b. Length of interval. Although mortality is not changing rapidly around the second birthday and beyond, it is still desirable to have women give PBT information at a consistent time, e.g., three months before birth or two months before birth. If the time of data collection is different for different women, some "noise" is introduced into the data. This can be partially controlled for if careful records are kept of the time of data collection, so that average intervals can be better calculated.

c. Changing cumulative mortality. We have stated several times that the cumulative risk of dying is changing slowly by the second birthday. However,

"[T]he risks of dying around age l-2 are still changing more rapidly month by month than at age 2-3, so that it may be harder to make a stable estimate of q(2) from data collected at ante-natal interviews" (Hill and David, 1994: 7).

It was found that in Bangladesh that cumulative probabilities of dying continued to rise rather rapidly beyond age two. While not common, such a situation makes application of the PBT in an ante-natal setting more problematic. For data from pre-1984, Bairagi et al. (1995) found that proportions dead collected three month prior to birth were closer to q(2y) than to q(3y). For pre-1989, however, proportions dead collected three months prior to birth was closer to q(3y). The researchers note,
"The differences between [proportions dead three months prior to birth and proportions dead at birth1 are very small..." They found a "relatively small effect of the reduction in the exposure period of the preceding born children on the probability of dying by age (x)" (1995: 12).

d. Selection. As with the PBT applied at birth, the PBT in an ante-natal setting suffers from selection problems. Especially relevant for the ante-natal approach is the fact that "there may be a direct or an inverse association between reproductive health and clinic attendance" (Hill and David, 1994: 7). Such associations would bias the resulting PBT downward or upward, respectively.

6. Validating the ante-natal approach

Hill and Aguirre (1990) presented theoretical arguments in favor of the ante-natal application of the PBT [check their paper again]. There have been few tests of the ante-natal PBT approach using actual data. We discuss the results of one of these below [and then do some simulations of our own??].

The Matlab experiment provides data which enabled researchers (Bairagi et al., 1995) to simulate application of the ante-natal PBT (as well as the postnatal PBT: see the next section). The Matlab continuous recording system followed pregnancies systematically and recorded exact age of mothers at birth and death of children. Life tables were constructed from the basic data and used as sources of the "true" mortality levels for two periods (pre-1984 and pre-1989). In addition, proportions dead were calculated for the data three months before the birth of a succeeding child [D(-3)].

As noted above, for data from pre-1984 the researchers found that proportions dead collected three month prior to birth were closer to q(2y) than to q(3y). By 1989, however, proportions dead collected three months prior to birth were closer to q(3y): birth intervals had lengthened in the intervening period and thus so would the intervals between birth and attendance at an ante-natal clinic. The researchers note, "The differences between D(-3) and D(0) are very small.. . For both dates, D(-3) still overestimates q(2). .. indicating the relatively small effect of the reduction in the exposure period of the preceding born children on the probability of dying by age (x)" (1995: 12).

As with their examination of the original PBT [B(0)], Bairagi et al. found that the PBT administered before birth was able to capture differentials by area, mother's education, and sex of child.

We might note that national trials using the ante-natal approach are underway in the Gambia (Hill and David, 1994: 7)

[Our own simulations here? Needed?]

7. What can programs do with ante-natal information?

Information on the level and trends in child mortality obtained from ante-natal applications of the PBT can be utilized in the same ways as discussed above for the at-birth PBT. In addition, one of the advantages of the ante-natal PBT mentioned above is especially important when we ask what can be done with the data once they are collected. This has to do with risk assessment and intervention. Women who are at risk of having their children die can be identified earlier with the ante-natal PBT than with the PBT administered at later periods. Thus, intervention efforts can be started earlier.

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CHAPTER 5: THE PRECEDING BIRTH TECHNIQUE WHEN MOTHERS ARE SEEN AFTER A BIRTH

In this chapter, we discuss the application of the PBT in a setting where data are collected after a birth. Similar to the ante-natal approach, this modification of the PBT depends upon the existence of an opportunity to collect data at a fairly similar time for all women having given birth. Such a point in time would often be when women take part in "an immunization program, an immunization coverage survey or another similar health intervention which is designed to reach all young children in an area" (Hill and Aguirre, 1990: 332).

1. Logic behind the postnatal approach

Once more, recall the basic logic behind the original PBT: proportions dead among previous births tend to approximate q(x), where x equals 0.81, the interval between the preceding birth and the moment of data collection. The postnatal variation of the PBT is based on the reasoning that it is valid to use intervals other than the inter-birth interval, e.g., I + 3 months or I + 12 months, which would be the average intervals between the birth of the preceding birth and the time when the index birth is seen, for example, in an immunization clinic.

a. Longer interval and higher proportions dead

Two important factors affect our understanding of the postnatal PBT. The first has to do with the increase in proportion dead due to the longer interval between the preceding birth and the time of data collection. This increase may be symbolized by y, the age of the succeeding (index) child at the time of data collection (say, the time of immunization). Then the interval between the preceding birth and the data collection will be I + y. Because this interval is longer than I, the proportions dead will be higher and hence will no longer necessarily be close to q(2y), as were the proportions dead for the PBT at birth.

What will the effect of this longer interval be? Recall that cumulative mortality levels are not rising very rapidly by the birth of the succeeding birth and rise even more slowly afterward. Hill and Aguirre (1990: 331) show that q(2y) comprises roughly 90% of q(3y). Figures on proportions dead would thus be approximately a 10% overestimate of what the proportions dead would have been at time of the birth of the later child. Hill and Aguirre go on to say that this suggests 10% downward adjustment of proportions dead when average age of children at intervention (and data collection) is one year.

b. Association between the survival of successive births

A second factor has to do with the fact that data on survival of some preceding births will be excluded from the data collection because the succeeding (index) birth had died before the time of immunization. This introduces a new source of bias in the procedure: only mothers with surviving children will be interviewed. Because mortality of successive births is related, the mortality of births preceding a non-surviving current child is likely to have been higher than the mortality of births preceding a surviving current child. To quote Hill and Aguirre (1990):

> "There is an association between the survival of the last born and previous child in every population, because excess mortality risks tend to be concentrated in some sub-sections of the population--poor, uneducated, badly housed, low-class families.. . The strength of this association...varies systematically with the overall level of child mortality.. .and the age of the last born child at interview. Thus, adjustment factors can be developed so that reports on the survival of the previous child obtained only from mothers with a surviving child born subsequently can be corrected to bring them into line with the same information obtained at the time of delivery" (Hill and Aguirre, 1990: 332).

Hill and Aguirre (333) developed a dependence factor they called f, defined as

$$\frac{\text{the probability of death to the later birth given that the earlier birth had died}}{\text{the probability of death to the later birth}}$$

A value of f greater than one implies that if the preceding birth died, it is more likely that the index birth will have died as well and thus will not be included in the data collection. If this is the case, a simple calculation of proportions of earlier births dead will result in an underestimate of the proportions in the absence of the association. A value for f of around 2 was found when the more recent child is six months of age or over for countries with IMRs around 100 (p. 335).

Hill and Aguirre (1990: 338) provide a table of adjustment factors to use with various combinations of f and infant mortality (we reproduce this table in Appendix [ADJFACT.TBL]).

c. Effect of the biases

How important are these biases to PBT calculations using data collected in a postnatal situation? As with the PBT at birth, such biases are not very important if they are constant and if you are concentrating on producing an IECM for one place and do not care if you can translate your data into other measures. If the non-childhood-mortality factors affecting a measure do not change, then the measure can catch trends in mortality even if it does not produce figures comparable to those from other sites.

Furthermore, the two major biases in the postnatal application of the PBT when compared with the PBT at birth tend to cancel each other out. The longer interval results in an upward bias, while the dependence among child deaths results in a downward bias. Let us imagine a situation where the IMR is about 100 per 1,000 births, f equals 2.0, and y, the interval between the later birth and data collection, is one year (Hill and Aguirre, 1990: 336). If the observed proportion dead is 0.2, then the adjusted proportion dead will be

$$0.2 \times 1.13 \times 0.9 = 0.203.$$

This represents an insignificant difference from the observed figure. The observed figure of 0.2 may be taken as approximately the IECM which would have been observed if the PBT had been applied at birth. [If the biases tend to cancel at one year, do they also tend to cancel at three months? Interval would be shorter, and the adjustment factor would be smaller...so apparently, yes.1

d. Calculations

Calculation of the postnatal PBT measure is no different than for the original PBT: deaths are divided by births to give the measure of proportion dead, the IECM. We discuss interpretation of the measure and problems involved with the postnatal approach below, after discussing the collection of postnatal data.

2. Administration and data collection

The postnatal PBT can be administered in several different situations, as noted above (an immunization program, a similar health intervention which is designed to reach all young children in an area, or an immunization coverage survey). Choice of one of these would depend upon which if any were up and running, which one had the most complete coverage (and best record of data quality), and which one occurred soon after the time of birth (to minimize biases). Choice of a immunization coverage survey would probably be made only if no other reasonable options existed, since such surveys are typically one-shot affairs and would thus not provide the information on trends which is so central to the usefulness of the PBT.

Because of the fact that the PBT only requires answers to a few questions, the additional load placed upon health service workers by its implementation is not very great. As with the ante-natal approach, the postnatal approach to the PBT requires data collection to be piggy-backed on a system originally designed to collect data for another purpose. For the postnatal PBT the most likely situation will be administration of a questionnaire at the time of immunization of the later (index) child. In such a setting, '*obtaining the information might be a greater burden for the immunization worker than for an ante-natal clinic or maternity clinic worker, since the questions used by the PBT are somewhat out of context in the immunization setting" (WHO: 709).

However, "Shuaib (1993) has shown that it is indeed practical to obtain the data on the survival of the preceding born child at the time of immunization of subsequent born children and that the results are comparable with mortality estimates from independent sources.. . The Shuaib paper...provides evidence from a major trial that data collection could effectively be combined with provision of a service - in this case, immunization" (Hill and David, 1994: 6, 8).

Several points must be kept in mind when collecting PBT data at time of immunization. First, as with the ante-natal data collection, "[t]he method requires each individual report from a mother to be separately identified on the record sheet rather than the simple tally sheet used by most vaccination teams" (Hill and David, 1994: 8). Alternatively, or additionally, one should utilize the child's immunization record held by the mother (Hill and David, 1994: 16), although the capturing of such data would be more complicated.

Secondly, the age of the more recently born child should be ascertained, so that y can be calculated. (Insofar as only an IECM is desired, this is not so important, for reasons noted above. However, if there is a range of values for y, or if y changes from period to period, knowledge of it would be more useful.)

3. Strengths and advantages

a. Coverage and selection

Although there will always be selection problems in any data collection effort that does not reach 100% (including vital registration), the presumable broad coverage of the postnatal PBT ensures that selection problems will at least be minimized. As we showed above with simulation examples referring to the PBT at birth, when coverage levels are "high," even if they are not 100%, problems of selection are not especially important, even if the non-covered population has substantially different mortality than the covered population [need to check this, of course!].

> [I]n developing countries, the proportion of mothers receiving ante-natal care or the proportion of children receiving at least one vaccination is much higher than the proportion of mothers delivering in a maternity clinic... Most of the criticism which has been levelled at the PBT has been in connection with the biases implicit in the results when coverage of mothers and children by the health services is incomplete... From the point of view of maximum coverage of the child-bearing population, this [immunization] is the most appealing moment to collect the data... [C]are would be needed to keep multiple reporting from the same mother to a minimum. Further, not all children are brought in by their biological mothers for immunization, but this proportion could be ascertained in field studies... Without doubt, the health intervention which reaches the largest fraction of mothers in developing countries is childhood immunization (Hill and David, 1994: 4, 8, 15)

b. Biases

As noted above, there are two important biases (increased interval length and association of child deaths) involved with administering PBT questions in a postnatal setting, but these biases tend to cancel each other out, so their practical importance is very small, especially if the major goal of data collection is an IECM and nothing further.

4. Interpretation, and analysis

a. IECM vs. q(x)

Apart from considerations similar to those regarding the at- birth PBT approach, there is only one major additional point to discuss regarding the theoretical interpretation of postnatal PBT applications. As with other applications of the PBT, this applies to the issue of interpreting the results as an IECM or in terms of a conventional measure of mortality.

The former is certainly easier: all one must do is calculate the proportion dead and report it as an IECM. This approach is best used when restricted to one site and to the goal of tracking mortality change over time. Since the major biases

cancel each other out, calculation of an IECM from postnatal PBT data gives a figure which is comparable to what would have been calculated using at-birth data, with the advantage that coverage is almost certainly greater.

Expressing proportions dead in terms of a conventional measure of mortality (i.e., q(2y) allows comparisons among different sites, both within one district and nation and across nations. However, all the problems with selection and other factors discussed with relation to the at-birth PBT are present here as well. Furthermore, one must assume that the two biases discussed above essentially cancel each other out.

b. Time location of estimate

The location in time of the estimate produced by the postnatal PBT will naturally be farther from the time of data collection than for the at-birth PBT. How long location in time is before the data collection can be estimated by I + y-AAD, where AAD is the average age at death for those preceding births who died. In the following diagram where surviving later children and their mothers are seen at y = 6 months, the location in time would be 30 + 6-l 0 = 26 months prior to the data collection.

```
Preceding                 Index Inter-
 birth     Death          birth vention
  |--------|--------------|------|
  0<-----------I=30---------->30    3  6
  |<---9--->|<-------21------->|     |
  |<---10---->|-------20------->|<-y=6->|
  |<---10-----|-------26-------------->|
```

[The following discussion from Bairagi et al. seems wrong; it seems to apply to PBT at birth and not some time (up to a year?) later; but maybe I'm wrong. Need to think more.] [W]hen the data are collected from mothers attending immunization clinics with their last born children, [the] estimates will refer to a period from about one year to 20 months before the data of the data collection. The time location will vary with the length of the birth interval following an early childhood death, with the level of mortality and with the prevalence of contraceptive use. Broadly, when mortality in high and contraception rare, the time reference will be close to 16 months before the time the data are collected. When mortality is low and contraception more common, the time reference will be close to 21 months before the time of data collection (Bairagi et al., 1995: 18-19).

5. Limitations and disadvantages

[These have essentially all be dealt with already. Need to think out the organization/outline a little better.]

a. Burden on workers (this is mentioned above)

"[O]btaining the information might be a greater burden for the immunization worker than for an ante-natal clinic or maternity clinic worker, since the question s used by the PBT are somewhat out of context in the immunization setting" (WHO, 1994: 709).

b. Loss of some index children (this is dealt with above)

"[I]t is clear . . . that the effect of omitting mothers whose children died before 3 months of age has only a small effect on the D values. The D'(3) values, calculated only from data provided by mothers whose children survive to 3 months, is never more than 4% below the D(3) value based on all mothers" (Bairagi et al, 1995: 12).

c. Longer interval: additional months of exposure can affect results.

"When the reports on the survival of the previous child are obtained not at the time of a subsequent birth but some y months later, the previous child will have been exposed to the risks of dying for the length of the mean birth interval, I, plus an additional period of y months, the age of the last-born child at interview. All other things being equal, this extra exposure will increase the proportions of previous children who have died compared with the case when the reports are obtained from mothers giving birth on a subsequent occasion. This upward trend in the proportions is independent of the correspondence between the survival of pairs of successive children._." (Hill and Aguirre, 1990: 335). More important if length of y is larger. For one year, perhaps a downward adjustment of 10% is justified (Hill and Aguirre, 1990: 336).

d. Biases of interdependence (f) and length of exposure (y) not important if they are constant, i.e., if the factors do not change and if all you want is an IECM, not a life-table level (HA, 336). Furthermore, the two biases, (y and f) tend to cancel themselves out (HA, p. 336) (do not advise a correction factor)

e. Changing coverage rates

"[C]hange of coverage rate in the immunization coverage with time will have little effect on the usefulness of the PBT for monitoring childhood survival when the initial coverage rates are already quite high..." (Bairagi et al, 1995: 20).

f. Selection bias, while there, is less (this was mentioned above)

6. Validating the postnatal approach

Hill and Aguirre (1990) presented theoretical arguments in favor of the postnatal application of the PBT [check their paper again]. There have been few tests of the postnatal PBT approach using actual data. We discuss the results of two of these below [and then do some simulations of our own??].

a. Bicego et al. (1989) used data from Haiti comparing postnatal PBT results with life-table estimates of child mortality obtained from a pregnancy register. They concluded with a warning "against general use of the preceding birth technique outside of the originally intended institution-based application" (Bicego et al: S30). [Not sure what to do with this.1

Bicego et al. found that the PBT administered at time of intervention overestimated the decline in q(2y) which had been directly calculated using life-table methods. They argued that at fault were the following factors, which would "normally remain unobserved and thus unaccounted for in a 'blind' application of the preceding birth technique using data collected at intervention" (p. S29):

-changes in the strength of the relationship between preceding and index birth survival (as mortality falls and risk become concentrated in certain portions of the population, the strength of the relationship tends to rise; as the strength of the relationship rises, its effect on the PBT changes);

-changes in the age pattern of under-five mortality (Bairagi et al. mentioned this as well: it argues against expressing the PBT results as conventional mortality measures);

-changes in the distribution of birth interval length;

-changes in mean birth interval length (changing intervals mean a changing value for x in q(x), but this can't be known if it's unobserved).

In addition, Bairagi et al. listed other factors which might "compromise the quality of estimates," including change in selection factors, change in data quality, and "the sundry other types of errors inherent to service data collection" (p. S29).

b. The Matlab experiment referred to above (Bairagi et al., 1995) tested the validity of the postnatal PBT approach as well as the original and ante-natal approaches.

The Matlab continuous recording system followed pregnancies systematically and recorded exact age of mothers at birth and death of children. Life tables were constructed from the basic data and used as sources of the "true" mortality levels for two periods (pre-1984 and pre-1989). In addition, proportions dead were calculated for all preceding births for three months after the birth of the succeeding (index) child, whether that child survived for three months or not [D(3)]. Figures for D'(3) were also calculated; D'(3) was defined as the proportions dead for all preceding births when the index child had survived to the simulated data collection time of 3 months after birth of the index child. D'(3) is thus the simulated proportions dead that would actually be observed in an immunization or other intervention clinic visited three months after the birth of the index child. "Therefore, the differences between D(3) and D'(3) measure the size of the selection bias attributable to the omission of mothers of succeeding or index children dying before 3 months of age" (Bairagi et al., 1995: 8).

Comparison of the values for D'(3) with values for D(0) and q(3) indicates that D'(3) is usually close to D(0) (recall our discussion of balancing biases above) and these two are in turn generally close to q(3).

As with their examination of the original PBT [D(O)], Bairagi et al. found that the PBT administered three months after birth was able to capture differentials by area, mother's education, and sex of child.

With regard to the problem of association of deaths, the researchers found that the "effect of omitting mothers whose children died before 3 months of age has only a small effect on the D [proportion dead] values. The D'(3) values, calculated only from data provided by mothers whose children survive to 3 months, is [sic] never more than 4% below the D(3) value based on all mothers. In rural Bangladesh, especially in 1984, childhood mortality was relatively high (infant mortality was 122/1 000), and so in most other circumstances with similar or lower infant mortality rates, we would not expect the differences between the biased and the unbiased case to be much larger than those shown here" (p. 12).

c. Shuaib (1993) tested the PBT in immunization clinics in urban and rural parts of Dhaka, Bangladesh, and for that "the PBT approach produced childhood mortality

estimates compatible with those from Matlab" (Bairagi et al., 1995: 18).

d. Our own simulation/sensitivity exercises: add three months of exposure; do for all examples; assume same women seen three months later --> what proportions dead? weed out those who died since birth and compare, cf Matlab paper (why do it again?). Selection, exposure effects. [Note: the appendix to Bairagi et al. is hard to follow.1

7. What can programs do with the information from the postnatal approach?

Basically, programs can do the same things they could do with information from the original and ante-natal approaches, except perhaps with more confidence because of lesser selection problems.

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CHAPTER 6: CAUTIONARY NOTES: LIMITATIONS AND RESTRICTIONS

In this section we summarize the limitations of the preceding birth technique. These limitations have already been discussed in various places throughout this booklet; we gather them here in one place for your convenience.

1. Can proportions dead be interpreted in terms of conventional measures of mortality?

Our discussions should have made it apparent that, while it is sometimes possible to interpret proportions dead as a life-table probability of dying by age x, it is not always either possible or desirable to do this. It is always possible to use the proportions dead as an index of child mortality (IECM). For a given situation, the IECM will be an extremely useful and timely indicator of the trends in child mortality over time. This is what the PBT was designed to do, and since it is what other methods do not do as well.

2. The length of the birth interval influences the value for proportions dead.

The basic fact regarding birth intervals is, for a given level of child mortality, the longer the birth interval, the higher the proportions dead. Thus, populations with longer birth intervals will tend to have higher proportions of previous births dead. this does not mean the results of the PBT are useless, it simply means the results need to be interpreted wisely. I practice this can mean one of two things: either use the results as an IECM, or use the results as indicating a value for q(x) with x not necessarily equal to 24 months.

3. Coverage: it is usually the case that not all of the population is covered by the PBT data collection. Thus, selection will make the results more difficult to interpret. As we noted above,

The principal factor responsible for problems in interpretation of PBT results is selection. Selection refers to the fact that the women giving birth (or, in a variation, registering a birth) who answer PBT questions about the survival of a preceding birth are not all women and are not even representative of all women who are giving birth in that time period. This means that, regardless of whether the PBT results are expressed as a q(x) value or as an IECM, they cannot be interpreted as representing the mortality experience of all children born in the area. Furthermore, if selection changes over time, the results cannot even be said to apply to an unchanging, even if unrepresentative, group of women and their children. Even more troublesome would be comparisons among populations with different patterns of selection.

There are several ways of dealing with selection problems in use of the PBT. The best, of course, would be to include all women giving birth in the sample, but this is obviously unlikely in the kinds of populations where the PBT will most often be used.

A second approach is to try to ascertain the nature of the selection bias: if, for example, it can be determined that well- educated women are over-represented in the sample, then it is likely the calculated IECM is an under-estimate of the true value. To study selection in this way, one needs to know characteristics of the sample. Insofar as learning these requires additional effort, it may be more trouble than it is worth.

A third approach involves doing sensitivity tests, in which assumptions are made about the extent of coverage and about the relative level of child mortality among the non-covered population. Such tests will tell if the IECMs are liable to be outrageously far from the true value or fairly close. When such tests have been done in the past, they have tended to show that the IECM is not seriously compromised by less-than-total coverage.

A final approach is to try to live with the selection. The IECM that is calculated for a certain clinic or district will be a true estimate of the level of child mortality for the women and births which are covered. If there is little or no change in the character of the selection from one time period to the next (which is likely), then the trends indicated by the PBT results will be good estimates of changes in child mortality for the group covered. Over long periods of time, of course, the character of selection will undoubtedly change, so long-term trends must be interpreted in this light.

4. Omission of last and only children. By its very nature, the PBT cannot collect information on the mortality of last children and only children: neither is followed by another birth. While such an omission might be a problem in low-fertility populations, in the higher-fertility populations where the PBT would normally be employed, the absence of last and only children has been shown not to be a serious problem.

5. Extreme and unusual age patterns of child mortality.

o "[I]n populations with extreme age-patterns of mortality, such as certain West African populations, the proportion dead of preceding births should be used only as an index of early childhood mortality to monitor trends (Hill and David, 1987). Converting the proportion dead to a standard life table measure of under-one or under-five mortality is not advisable in this case. This is because the model mortality patterns upon which the method is based do not incorporate the age- pattern found in parts of West Africa, and therefore the age to which the estimate refers is undetermined" (David, Bisharat, and Kawar: 315.

o "PBT estimates of early childhood mortality should not be used to estimate infant mortality but should be retained as good estimators of q(2) when birth intervals are less than 30 months and of q(3) when birth intervals are longer" (Bairagi, 12, 15).

o "In some situations, in which l-4 mortality remains high in relation to infant mortality due to diarrhoea and acute respiratory infections (diseases for which we have no effective vaccine), q(3) may in any case be preferable to q(2) as a measure of program impact" (Bairagi, 19).

6. What if deaths are concentrated in a few families?

In our discussion of the postnatal PBT we noted that there is an association between the death of one child and the death of its succeeding sibling. That is, mortality within families is correlated. It has been found that as mortality falls within a population, the correlation goes up: death of a child is more likely to be followed by the death of another child in the same family AND survival of a child is more likely to be followed by the survival of another child. For purposes of the PBT, the importance of this fact is that there will be an increase in the bias associated with successive deaths (i.e., deaths of previous births will not be caught because the index birth has died before data collection)... [research this a little morel

7. What if mortality and/or fertility are changing?

Changing pattern of child mortality; Bicego et al. talked about this, citing a change in $_3q_2$ as one source of wrong estimates produced by the PBT.

Effects of falling fertility

"These authors have shown that the PBT a) detects satisfactorily

trends and differentials by social class even when mortality and fertility, including birth interval length, are changing..." (Hill and David: 5).

8. What about effects of parity?

By parity: don't use "..birth interval distributions vary with order; it would be necessary to estimate I by parity of women. In addition the selection bias from omission of final births . . . might significantly distort differentials. The extreme simplicity of the method, which is its strongest attraction, disappears." (BM, 1984: 7).

G. Other points (scattered through PART-III.WKG)

More subtle biases by age, parity, and social class.

Use of PBT in a survey (see David, Bisharat, and Kawar; David, Bisharat, and Hill)

vocabulary/language problems

- o vocabulary problems (HA, 326)
- o demographic ct medical definitions (David and Hill: 10)

demographic vs. medical definitions: In Bamako, some confusion between terms for a pregnancy or a confinement, a live birth, a stillbirth, and a miscarriage. "'Parity' in medical parlance frequently includes stillbirths and possibly miscarriages too. .., in the application of the preceding-birth technique, it is the survival of the preceding live-born child which concerns us, even if a miscarriage intervenes between this birth and the 'current' delivery" (HA, 326). More on language problems: loc. cit.

Tendency to report very early deaths as stillborn (HA, 326) [does this go under this heading?].

Additional information that could be collected

sex, date, etc., of previous birth

"If this question is supplemented by one concerning the length of this birth interval, the possibilities for increased precision and control are extended." (BM, 1984: 6)

"A variation to the methodology was to obtain the date of birth of the preceding child as well as the date of death of the non-surviving children. This additional information allows infant mortality to be calculated directly rather than through using the assumptions of model life tables and allows more precise dating of the mortality rate" (Rutstein: 2).

Second-to-last birth "Macrae (1970) indicated that the same general approach can be adopted with reference to the reports obtained form mothers at the time of the current maternity on the survival of their second-to-last children... [T] proportions dead of these second-to-last births in high fertility populations will be not far from q(5)" (HM, 1985: 7-8).

"Incorporated into a regular system of data collection, the results, along with extra information such as mother's age, marital status or birth-weight of current child, can be used to follow trends in child mortality closely, in particular for assess programme impact, for following targeted groups, or for both purposes" (Pickering et al: 72).

"[Ulsing the other variables such as mother's age, parity and birth weight of the new-born" will allow further analysis" (HA, 326).

Data on previous birth (Hill and David, 1994:17):

- date of birth
- age at death
- sex
- single or multiple birth
- birth weight if known
- full term or premature
- assistance at and place of delivery

Data on mother (Hill and David, 1994:17)

- parity or gravidity
- age or marriage duration
- marital status
- living children
- education
- social class

Associated factors: Li looks at age of mother, residence, mother's education, birth order of PB, assistance at PB, and sex.

medical assistance/clinic delivery: Li looks at medical assistance, finds much higher Ps for those without assistance (p. 14). Once again, she found high consistency between 08.1 and P.